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STATE OF MICHIGAN,

MINES

AND

MINERAL STATISTICS

BY

CHAS. D. LAWTON, A. M. C. E.,

COMMISSIONER OF MINERAL STATISTICS.



BY AUTHORITY.

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STATE OF MICHIGAN,

Office of the Commissioner of Mineral Statistics, Lawton, Michigan, June, 1888.

HON. CYRUS G. LUCE,

Governor of the State of Michigan:

SIR,—In fulfillment of the duties of my office, I have the honor to submit herewith the following report upon the mines and mineral interests of the State.

Respectfully your obedient servant,

CHARLES D. LAWTON,
Commissioner of Mineral Statistics.



INTRODUCTORY NOTE.

As in former Reports this volume is largely devoted to descriptions of mines, the aim being, chiefly, to bring the record down to the present time.

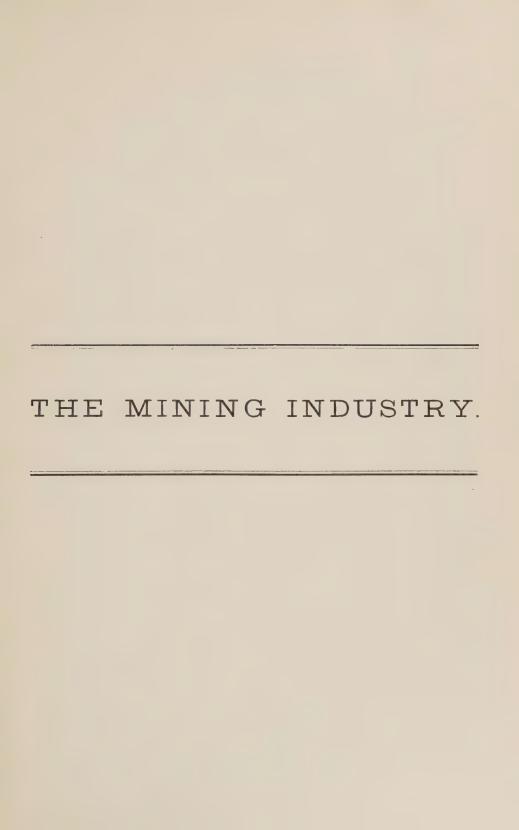
I am encouraged to adhere to this practice, which has continued since the office was created, ten years ago, as there are many people in this country and abroad who are eager to obtain information about the mines of this State and who have come to regard these Reports as convenient and reliable sources to consult.

I am assured from the information that comes to me in many ways that these Reports have been of much benefit to the mineral interest of the State, and I have made every effort that the present volume shall be in keeping with those that have preceded it. It is somewhat briefer than the more recent ones, but it will not, I think, be found that on that account anything material has been omitted. While the volume is designated as the Report for the year 1887, it is strictly such only in matter of products; since although the book was mainly written in the winter of 1887–8, I have been enabled, through delay in publication, to visit the mines during the spring and summer of the present year, and thus to revise my manuscript and bring the information down to date. The maps of the leading copper mines are from new plates and show the workings up to the close of the year 1887. I have also added a map of the Chapin mine showing elevation, cross sections and ground plan. I would like to give similar maps of other leading iron mines, but I found that the cost of engraving was greater than I could afford.

There are some very interesting, and practically important, mining and geological facts that appear in the mines, particularly at Ishpeming, in Menominee county, and still more especially in the Gogebic range, that I have alluded to and endeavored to explain, but which can be much better understood with the aid of maps.

I must continue to acknowledge my obligations to mining officers and others for uniform kindness and assistance. My long connection with the Lake Superior country has enabled me to establish frank and confidential relations with almost every one connected with the mining industry in this State that are at once pleasant to me personally and of advantage in obtaining the necessary information for my Reports.

COMMISSIONER.





THE MINING INDUSTRY.

The year 1887 closed with a somewhat dull outlook for the iron mining industry but a hopeful one for the copper. It seems doubtful if the advance in the prices of ore which was made at the opening of the year and which has held throughout the season will still be maintained. There is every prospect of a retrograde in prices.

At this writing no sales of ore for next season's shipment are reported. The mine owners are asking last year's prices for their ore, but expect to be compelled to accept less. It is reported that as much ore will be wanted, but there will be a greater production. If there is a market for it more ore will be mined. Many of the mines are in condition to produce more ore than they ever have before. It is only a question of demand.

Notwithstanding that ores sold at an advance, generally about a dollar a ton above the previous year's prices, it is probable that few companies realize thereby any great increase of profit. An advance in ore means also an increase in th price of labor. Miners' wages invariably advance with the demand for ore. In other ways there is also an increase of cost added. the greatest drawback in the iron ore mining business in the Lake Superior region the past year has been the matter of transportation, especially of lake transportation. The difficulty in securing vessels and the excessive charges for carrying by water to the ports to which the ore is uniformly consigned became so great as to amount to a virtual embargo on the mining business. Those mining companies which had secured contracts with the vessel men for the season were indeed fortunate. At the beginning of the year the charge of \$1.40 per ton for the season's carrying of the ore from the port of Escanaba to Cleveland seemed exorbitant, and generally the mining companies hesitated to close their contracts at those figures; it was expected that lower rates would soon prevail, so that in most cases only limited contracts were entered into, that is contracts that covered only a portion of the season's product. But instead of lessening, the vessel rates rapidly appreciated, until before the close of the season the advance was, in instances, seventy cents on a ton, becoming \$2.00 to \$2.10 per ton for carrying the ore from Escanaba to Cleveland. The same, of course, was true of Marquette and other shipping points, and if we add to this the railroad charges of eighty cents per ton and thirty to fifty cents per ton for royalty we readily see that the circumstances for mining must be extraordinarily favorable in order that any profit should accrue on ores that must sell at \$4.00 per ton. In point of fact where such conditions prevailed there could be no profit at all. Mines in low priced ores that were at the mercy of the vessel men were forced to shut down or discontinue shipping; if they had contracts to fill and thus continued to ship they did it at a loss, or at least with little or no profit. Other companies having high priced, rich Bessemer ores, and who had made contracts early in the season and were able to secure their execution, have naturally a better showing of the year's business.

The scarcity of vessels, the irregularity of their trips, the uncertainty in the time of their appearance in port, gave much embarrassment to the mining companies, delaying the work and added to the cost of the ore aside from the increase in the rates of transportation.

There was no end of trouble throughout the season from want of cars. The mines were hampered beyond measure throughout the season by this restriction.

It generally facilitates the mining and lessens its cost if they are able to discharge the ore, as it comes up out of the mines, directly into the cars; all the expense of subsequent handling is thus avoided. If not dumped into the cars or into the pockets ready to shute into cars, it must be run out onto an ore dock and thence subsequently transferred into cars, generally by the ordinary process, with wheelbarrows and shovels.

When vessels are sufficient and regular, the ore docks at Escanaba, Marquette and elsewhere have room for the constant reception of ore, and the flow of ore in and out is unceasing. But if vessel transportation is inadequate then speedily there is a glut; the pockets in the ore docks become filled; the cars of the railroad companies are full and left standing on the tracks, and sometimes even the docks and pockets at the mine are loaded to their entire capacity, in which latter case such a mine is nearly at a stand-still. There is little for the miners to do maybe; they must work at a disadvantage to the company. Perhaps the company may be prepared for pushing its shipping, may have a force of men to load the accumulated ore into the cars; if there are no cars the men are idle. The company may be forced to keep them, not knowing how soon their services will be required, and realizing that in an emergency it could not, probably, secure them speedily again. When a vessel arrives it expects to load on the shortest possible notice and to quickly be on the return journey; no delays or excuses for delay are admis-

sible; if delay arises in ever so small a degree, some party must pay the cost, and generally the mining company, in addition to its other burdens, is also saddled with this, though in truth it may not be at fault.

When vessels come for the ore that happens to be in the docks in the harbor there is no trouble, but when the demand is for ore that is still at the mine far away then indeed there is sometimes commotion and hurry; if sufficient cars can be had quickly, the emergency is generally met. All the available force at the mine is put to loading cars, and a train is soon in readiness to dispatch. But sometimes the railroad companies cannot furnish enough cars, and this happens more often than otherwise; then the vessel is perhaps delayed and there becomes a matter of damages, which is to be adjusted between the railroad company and the mine owners.

Facilities for railroad transportation have much more nearly kept pace with the growth of the mining industry than have those by water. There has been great advance within the thirty odd years that have transpired since the primitive tram road from Ishpeming to Marquette gave place to one with iron rails and the mule team to the locomotive engine. For ten years this sufficed, and when in 1865 the Peninsula road was opened between the mines and Escanaba, and a fine ore dock was built at the latter place, it seemed that the acme of progress was attained. Eight years thereafter and connection was made by rail to Chicago, and the original line, which had been from time to time added to and pushed westward, was further elongated to the head of Keweenaw Bay, where an ore dock for vessels to load was built, as in the meantime additional ones had been constructed at Marquette and at Escanaba.

A few years thereafter and the discoveries of ore in the Menominee district led to the building of the Menominee River Branch of the Chicago & Northwestern, and of its later extensions northerly and westerly to the Paint and to the Iron river, and soon after further developments occasioned the opening of the branch to the Felch Mt. range. More recently still the line to the Straits of Mackinaw was constructed and thus connection made with lines reaching east and south. But it is within the past two years that seemingly the greatest changes in this matter have occurred. The Milwaukee & Northern has opened its line from Champion to Chicago, passing through Republic, Iron Mountain and Menominee in Michigan, and is preparing to build branches to the various mines, and to compete for the carrying of the ore. The portion from Iron Mountain to Champion has been constructed in the past year, and within the same time has been built a western prolongation of the Menominee River Branch of the Peninsula Division of the Chicago & Northwestern R. R., from its western terminus at Iron River, 35 miles to Waters-

meet, to connect with the Milwaukee, Lake Shore & Western R. R., which latter reaches from Milwaukee to Ashland, passing along through the mines of the Gogebic Range.

In the business of handling these ores this railroad is now met with the competition of the line that has thus pushed westward, and which has already engaged in carrying the Gogebic ores over its line to Escanaba. And it i further crowded by the Wisconsin Central, which latter company has constructed a branch from Ashland east to the Gogebic mines and built an ore dock at the above named port.

And this is not all. In the past year the Marquette, Houghton & Ontonagon company, which had a year or two previously extended its road to Houghton, passed with the Detroit, Mackinac & Marquette line to the ownership of a new company, the Duluth, South Shore & Atlantic, which organization is already vigorously at work building its road through the western part of the peninsula, and will, when completed, give a through line from Duluth to Marquette, Houghton, Sault de Ste Marie, Straits of Mackinac, and in fact with all points east, west and south. A branch will also be built to the harbor of Ontonagon, and thus all important points in the Upper Peninsula will be connected by rail.

Already the northwest has direct connection with the extreme east through the eastern portion of the peninsula by a rapidly constructed line that is but just ready to be opened for traffic, the Minneapolis, St. Paul & Sault de Ste. Marie R. R. It crosses into Canada over a magnificent bridge that has been made to span the St. Mary's River.

The copper district has been made accessible by the building of the road from L'Anse to Houghton, thus giving daily trains between the latter place and Marquette, in fact with Detroit and Chicago, etc. And the spanning of the lake between Houghton and Hancock with a bridge on which trains may cross permits of direct connection between Houghton, Calumet and Lake Linden, etc.

The C. & N. W. Co. has added to its equipment in the past year 500 ore cars that hold 20 tons each and upwards; 26 tons of ore may be loaded into them. The Mil. & Northern and Mil., L. S. & W. Cos. had previously introduced these large ore cars; but the C. &. N. W. Co. has found it expedient to modify the form of the body of the car somewhat in order to make the car conform in heighth to the ore docks, ore shutes, etc, at the mines; in fact they are made the same heighth as the small cars so long in use, and in conformity with the heighth of which all the arrangements at the old mines have been made.

The C. & N. W. Co. is also building an ore dock at Escanaba, where it

already has three. The fourth, when completed, will make the aggregate capacity 90,000 tons. There are three ore docks at Marquette, but they are greatly inadequate to what is required. The R. R. Co. is now taking steps to increase the capacity for the temporary storage of ore. In addition to these the same company (D., S. S. & A.) has two other ore docks, one at St. Ignace and one at L'Anse. The M., L. S. & W. has two at Ashland, and the Wisconsin Central one, and it is said that the M. & N. Co. contemplates building similar ones at some point at the head of Lake Michigan.

As it is there are 12 ore docks for loading vessels with the ore sent from the Michigan mines.

The rapidity with which this work of loading can be accomplished is illustrated in the fact that in August last, in a period of less than three days, 60,000 tons of ore were transferred from the docks into vessels at Escanaba. It simply so happened that there were vessels enough in continuous attendance for ore to keep matters moving.

But as before stated, while there has been much progress in the matter of railroad construction with the view to meet the needs of the mines, the same can scarcely be said of the increase of facilities for water transportation. Throughout the season for shipping there is a constant complaint of the want of vessels. All through the spring, after the opening of navigation, and early summer, when the winter's accumulation of ore should have been moving rapidly forward, there were few vessels; they were mainly engaged in moving grain, and as a consequence the mines were much hampered; their docks were already full and they could not obtain enough cars in which to dump the ore that came out of the mines. The vessel owners had matters all their own way the past year.

They were driven with business and charged exorbitant rates. The parties who made the most money out of the ore business the past season were probably the vessel owners.

It is an undoubted fact that the growth of the north and northwest, of the country whose business thoroughfare lies through the waters of Superior and the lower lakes, has outgrown the facilities provided in these channels for transporting its products. The iron ores of Michigan and Minnesota, much of the pine, the copper, slate, sandstone and other minerals, the flour and grain from Minnesota, and the great grain fields of Dakota and the Red River of the North, find their natural outlet through the channel of Lake Superior. This vast area, rich in an untold degree, is yet in its veriest infancy, and its carrying trade is but a tithe of what it may be expected to become in the future, and yet the means adopted for overcoming the natural obstructions to the commerce of the great lakes are nearly taxed to their utmost capacity. The

ship canal at the Sault has little capacity in excess of what is already required. It must inevitably soon become inadequate, and then the ship canal that connects the waters of Portage Lake with Superior is scarcely an apology for what is required, if the wants of the commerce of Lake Superior are fully met. Certainly this canal should be deepened, as should also the channel at the eastern entry, and both rendered free as the air, so that vessels of the largest build could freely pass without danger or hindrance, either natural or legal.

It is somewhat of an anomaly that a government which is burdened with a plethora of wealth, that complains of the distended condition of its treasury, and affects to be greatly alarmed at the influx of treasure into its vaults, should object to dispensing a moiety of this burdensome treasure, in freeing these waterways of the restrictions which hamper the traffic through them, and out of the nation's great abundance of treasure to pay for such enlargements and improvements as shall enable any vessel that floats upon the waters of Lake Huron to be as readily passed to the surface of Superior as to that of Lake Michigan. It cannot be otherwise than a mistaken policy which neglects any measure of improvement in these great waterways of the nation.

Certainly a surplus burdened nation has no occasion to scruple in the matter of expense.

No better disposition can be made of millions of the surplus, as much as is necessary, than to expend it in improving the Sault Ste. Marie's, the Portage Lake canals, in deepening the channel through Lake St. Clair, and elsewhere along the watery route; in improving the harbors, making them safe, commodious and accessible; and in every needful way rendering this great thoroughfare adequate to the wants of the rapidly increasing commerce of the growing northwest.

Every year makes noticeable changes in our mines; new ones are added, old ones become deeper and larger; there is something new to be noticed at nearly every mine in the way of machinery, methods of working, in the deposit of mineral, and in many things that give interest and variety to the industry.

As usual there has been much exploring done, and out of it all some valuable results have been obtained; noticeably among these are the finds of ore recently made in the vicinity of Crystal Falls, in township 43, R. 32, to be hereafter described; and also west of Lake Michigamme, in T. 48, R. 31, in T. 47, R. 30, and near the city of Negaunee. Also at Norway additional ore has been discovered to an extent to render it probable that a large mine of Bessemer ore will be soon opened.

Discoveries have been made on some abandoned properties that make them

again of considerable value, as the Curry, the Manhattan, the Argyle, etc. In very many places discoveries of ore have been made, most of which I have personally examined, and some have ore of good quality and afford indications of there being an abundance of it.

The practice of filling the mines, that is, filling up the spaces made by removing the ore, with rock and sand, etc., I am pleased to observe is taking a permanent foothold, and coming to be practiced as one of the established methods of mining in Lake Superior.

I regard this as a noticeable advance; it is safer and cannot but be more economical in the long run than either of the methods of sustaining the walls by having ore pillars or by elaborate and costly timbering. The system of filling in the Chapin is now working excellently well, and they are putting it into full practice at the Norway and Vulcan mines, and elsewhere it is fully or partially resorted to. At nearly all the old mines the plan to be adopted to mine out the pillars that have been left and which in some instances amount to 50 per cent of the ore which the mine contained, must arise and must be decided in one of two ways, either by filling the mine first and then removing the pillars and ore, or by first wrecking it and reaching the pillars through the crush. Probably where the ore in the pillars is all that is to be obtained, a combination of the two methods will be practiced.

The speculative excitement in mining stocks, options and property which prevailed in the Gogebic district at the opening of the year has had its natural outcome: a reaction has taken place, and a great shrinkage or utter collapse in the fictitious values which had obtained. The result is much disappointment, pecuniary loss, financial ruin and depression.

The good mines are now estimated at more nearly their true value, and will assume a more natural, healthy life in future. Probably the condition of things will by and by become as they are in the older iron sections of the peninsula, the crude and exaggerated notions, which have in a measure prevailed will be replaced by sober sense, by ideas based upon well comprehended facts. Ore deposits will have to be estimated according to their proved value, instead of being rated from a basis that is largely or wholly imaginary or assumed, as has been the case with many of the so-called mines in the Gogebic range.

There are fine deposits of ore in this district and they afford all reasonable conditions for systematic and profitable working; probably there is a prosperous future in store for the companies holding such mines. Some of them are certainly remarkably fortunate. They possess deposits not only of great magnitude, but the ore is of such purity and excellence as will insure its demand whatever may be the conditions of the market. It is this fact, the fact that

the ore, wherever found, is so generally Bessemer, that has enabled interested persons to stimulate the speculative craze that prevailed. Of course they have had the Colby and other large mines as existing facts and persuasion, imagination, and, not unfrequently, misrepresentation has done the rest. But it has all come to an end. There has been an utter collapse in these distorted assumptions, and numberless men have proved to themselves how ephemeral indeed are riches. The coveted wealth that they may have thought to possess in these inflated mining shares, has suddenly vanished "into air, into thin air," and the magic gold has turned to ashes upon their lips. These unfortunate experiences of so many will result in greater conservatism for a time at least. But another generation, with more imaginary wisdom, will be just as ready to grasp at some similar bubble and will in the end find itself in like predicament.

Aside from the collapse of the speculative boom along the Gogebic range, the valuable working mines have not found the year one of great profit, generally. This has been due to the excessive cost of transportation and to the low price of ore. The larger mines have made money, but not as much as was anticipated.

But the greatest change for the better has taken place in the copper region; the sudden rise in the price of copper that has occurred at the close of the year 1887, has put an entirely different aspect to the business of copper mining. At the opening of the year 1887, the price of copper ruled at about 10 cents per pound, but at the close of the year it is 17 to 19 cents. The advance has been made in a few days, and while it is no doubt in a measure speculative it is at the same time based upon causes that must insure the price of copper remaining at a considerably higher figure than has heretofore prevailed for the past two years, and while it is not necessary to enter into a discussion of these causes, I deem it reasonably certain that the price of copper will be from 13 to 15 cents the ensuing year. Of course this means prosperity to the Lake Superior copper mines. If they can live on copper at 10 cents, they can make a great deal of money when copper is 15 cents.

If the price of copper was to remain permanently at 10 cents per pound, the most of the mines in the Lake Superior country could have little value. The Calumet & Hecla, Tamarack and the Quincy could still make money for the stockholders; but the others, in varying degree, could simply live and keep up their equipment and a good surplus. To be sure the Osceola, Atlantic, Central and Franklin Co.'s pay small dividends to their shareholders but it is doubtful if it is wisdom to do it, that if the money will not be required by and by in renewing or increasing their equipment.

The Calumet & Hecla Co. has had a serious experience, and now at the

close of the year there is not much of a silver lining in the clouds which overcast its prosperity. The fire which broke out in this mine in August last and which caused the closing up of all the shafts until it could be extinguished with carbonic acid gas, again broke out on Nov. 20th, and the shafts are now closed at the top and the work of endeavoring to extinguish the flames by the application of carbonic acid gas is vigorously pursued. If this fire were to spread and involve the whole mine in its ravages the effect would be serious indeed. At the present time it is thought at the mine that the origin of the fire is the work of incendiarism.

With this unfortunate exception the year of 1887 closes auspiciously for all our mines, both of iron and copper. There is every reason to think that 1888 will prove as prosperous as has 1887. Ores will probably be a little lower in price, but there will be, undoubtedly, a saving in freights that will compensate the companies.

In southern Michigan there has been a great deal of interest shown in the matter of gas exploration, that is, in boring in the earth for the purpose of obtaining a flow of natural gas that should be sufficient in quantity for lighting and manufacturing purposes. Very many wells have been projected and borings have progressed in various parts of the State to a depth of from a few hundred to 3,000 feet. But only at Port Huron has gas been obtained in quantity sufficient to be of any practical value.

It is not expected to find gas beneath the surface of our State in quantity to be of value until the Trenton limestone is reached, if at all, and as this lies at a great depth it follows that the investigators must be provided with a good deal of patience and not a little length of purse. If both these hold out they may reach the Trenton limestone within the depth of 4,000 feet and possibly find gas. In this boring at different points many thousands of dollars have been expended in the past year and in some places the work is not yet abandoned, merely suspended during the prevalence of cold weather.

One good result will arise from this work: we shall know more about the crust of lower Michigan than we did before. So many borings in so many different localities and to so great depth become very valuable if we know all the data. Fortunately Mr. C. E. Wright, the State geologist, has the matter in hand. At his request many of the parties making these borings are preserving specimens of the rock passed through with the drill at each five feet in depth. Mr. Wright furnishes small labeled bottles for this purpose, in which to put the specimens and the record on the label.

From these specimens a geological section of each boring can be accurately constructed and thus gives a pretty definite knowledge of what the crust is composed down as far as the drill penetrates. These explorations are so

numerous, are at places along Lakes Michigan, Huron and St. Clair, the southern border and in the interior of the State, that the results in the hands of so competent a geologist as Mr. Wright are invaluable. They are the data for geological sections of the lower peninsula such as were never before afforded.

THE JACKSON IRON COMPANY.

The Jackson mine, after being for 30 years under one management, passed into other hands, and thus for the first time for so long a period, other parties are directing the work. Capt. Henry Merry and Mr. Edward Blake, who had come to be regarded as life long fixtures at the Jackson location, are no longer responsible for its fortunes. The new agent is an old resident of Negaunee. He has known the Jackson mine almost from his boyhood; he is an experienced miner and mine agent, and has made a fortune through his success in this business. He is also one of the chief owners of the Jackson, so his pecuniary fortunes are identified with its success.

It has long been thought by some people, that the old management at the Jackson was a little slow; that a little more enterprise and go-aheaditiveness were in order. If such were the case, then the change will be for the better, for Capt. Mitchell has the reputation of being an energetic man. In visiting the mine recently, I find that there is need for the exercise of all the skill that he may possess in his endeavors to discover ore.

The fact is, when he took possession of the mine there was not much ore in sight, and it was by no means certain where ore in quantity would be found. Capt. Mitchell has kept up a pretty diligent search for it the past season, while at the same time managing to obtain a larger product than it has been customary for the Jackson mine to furnish for the past few years.

The chief piece of new work which has been in progress the past season is the sinking of a new shaft west of the Merry pit, and north of the railroad track, to reach a body of ore that was found years ago with the diamond drill. I have previously given, in a former report, a record of this find. The new shaft is inclined down to the northwest at an angle of 45° and has been all the time in sand, etc., 95 ft. of it. They have been since last March till December, getting through this sand. The shaft had just reached the quartzite ledge.

Northeast from this point they were boring with the diamond drill, had bored one hole which penetrated 13 feet of ore, and had started the drill at a different angle for a second hole. There is quite a body of ground in the northwest corner of the property that has never been explored to any great extent. It is favorable for the occurrence of ore, and Capt. Mitchell proposes

to give it his attention. On the west line, under the bluff adjacent to the old No. 10 of the Cleveland company, they are mining a small amount of ore. It lies pretty flat and they are down 60 feet. It don't promise to be very large. In the east end of No. 5 pit is a stope 6 to 8 feet wide, and No. 7 is looking as well as ever. It is the main dependence of the old mine.

Some development work is in progress at the South Jackson; three shafts are sinking, and the ground will be tested to greater depth than has been done heretofore.

The mine will furnish as much, probably more, ore the coming season than it has done in any former year.

I forbear to enter into any detailed description of this mine, I have done so in former reports and I do not deem it necessary now.

MAJOR FAYETTE BROWN, Gen'l Agt. Jackson Iron Co., Cleveland, Ohio.

CAPT. SAM. MITCHELL, Prest. and Gen'l Manager.

Annual products of the Jackson mine are given in the following table:

Year.	Tons.	Year.	Tons.
Previous to 1856 (estimate)	25,000	1872	114,910
1856	417	1873	130,131
1857	12,442	1874	94,708
1858	10,309	1875	87,283
1859	28,377	1876	98,480
1860	41,295	1877	80,340
1861	12,919	1878	83,120
1862	46,046	1879	112,921
1863	77,237	1880	120,622
1864	83,905	1881	118,939
1865	65,505	1882	93,670
1866	92,287	1883	71,278
867	127,491	1884	76,626
.868	130,524	1885	67,657
869	125,908	1886	89,525
870	127,642	1887	109,947
871	132,297		
Total			2,694,839

THE EAST JACKSON,

formerly the Pendill mine, joins the Jackson mine on the east. The old mine shaft is but a few feet south of the railroad track at the union depot in Negaunee. The property is the west part of the S. W. ‡ S. W. ‡ Sec. 7-47-26, and is now held on a lease from the Pendill estate, by Hon. J. Q. Adams, Capt. J. F. Foley and others of Negaunee. Some explorations have been made with a diamond drill and good results obtained. A boring 200 feet in length at an angle of 45° with the horizon, so taken to be at right angles to the formation, cut, I am assured, 38 feet of ore.

Also at a distance of 14 feet from this boring, a width of $17\frac{1}{2}$ feet of hard ore was obtained, which if it all is like the specimens shown to me this ore is of fine quality.

The Pendill mine produced in the aggregate, from 1878 to 1883, 27,000 tons of ore.

THE LUCY MINE,

formerly the McComber mine, is next north of the Pendill and east of the Jackson. It was idle, since 1883, until the beginning of 1887 when it was re-opened and is now operated by the Lucy Mining Co. No important changes have been made; the machinery was all intact; it was only necessary to put it in order and pump out the water. The mine is an old one and the location presents a number of large open pits that have been formerly worked. The mine is now all underground and is reached by two main shafts through one of which most of the ore obtained the past year has been hoisted.

This is designated as No. 3 and is situated a short distance southwest of the engine house; it is 230 feet deep and they are about to sink to another level, 50 feet. In the bottom are three drifts, one to the southeast in the direction of the new shaft 170 feet long. In this drift is a body of ore which is shown to be 30 feet wide and 150 feet long; it will also be reached from the new shaft in a drift coming north. To the southwest from No. 3 shaft is a drift 110 feet, and another to the northwest to cut along near the east side of a large open pit where ore is expected to be found. The new shaft, No. 5, is sunk in the foot wall side at a distance of about 300 feet from No. 3, in the southwest direction. It is 178 feet deep and is 12'x14' inside the timbers down to a depth of 170 feet. In the additional depth to which it will be sunk it will be made smaller, 8'x12', large enough for double cage and ladder road. At about 150 feet east of the new shaft they are sinking in the bottom of an old pit and hoisting with derrick and bucket. In the bottom of No. 5, the new shaft, they have cut a drift east 100 feet and then south 100 feet through a body of ore 20 feet wide. Capt. James Rowe, the superintendent, estimates that he

will raise at least 30,000 tons of ore the coming season of 1888. The product in 1887 was 11,584 tons, and the annual products in previous years are as follows:

Year.	Tons.	Year.	Tons.
1870	4,856	1879	28,96
1871	15,442	1880	31,02
1872	25,030	1881	28,23
1873	38,332	1882	40,39
1874	2,642	1883	14,67
1875	10,357	1684	
1876	17,282	1885	
1877	19,691	1886	
1878	30,180	1887	11,58
m		11	
Total			319.

The mine is in the N. W. cor. of Sec. 6, T. 47, R. 26, in the city of Negaunee. It is situated in the side hill that slopes somewhat steeply down to the north for a distance of upwards of a quarter of a mile.

The officers are: Wm. H. Barnum, Pres., Lime Rock, Conn.; A. Maitland, Gen. Manager, Negaunee, Mich.; James Rowe, Mining Capt.

THE MILWAUKEE MINE

still holds the prominent place which it first assumed among the Negaunee hematites, having shipped 51,000 tons the past season. The mine is still operated by the Carmichael Bros., for the company on contract, and I find on examination that they are reasonably sure of the usual product the ensuing year. Still all the pits to the east have been gradually exhausted, until now the stoping is confined to No. 8 and to No. 9 pits, the latter holding still, as it did a year ago, the chief ore deposit of the company. It has a length east and west of about 175 feet and a width of 40 to 50 feet. All the ore lenses on this property have been found to lengthen to the west and shorten to the east, that is the lenses "pitch to the west," as it is termed. Each succeeding level extends further to the west than did the one above it. The misfortune with the Milwaukee is that the No. 9 pit has reached the west line of the property and the ore passes to the Grand Rapids people. Luckily the ore body in No. 9 has not, in the last few levels, shortened on the east, so that they still have the ore, within their line, of the same length. In my last report I mentioned the fact that they were sinking a downright shaft to mine the ore in No. 9; but this work has been abandoned. The shaft penetrated

the body of ore, and so would require that pillars of ore should be left to insure stability; it was deemed inadvisable to do this. Some exploring is doing elsewhere on the property, but no striking results have been obtained as yet.

The ore is somewhat variable in quality, but it averages above 60% in metallic iron, and but little above the Bessemer limit in phosphorus; in fact the ore used to be sold for Bessemer.

Mr. A. Kidder, Agent, Marquette, Mich. Carmichael Bros., Mining Contractors, Negaunee, Mich.

The Milwaukee has produced annually as follows:

Year.	Tons	Year.	Tons
1879	941	1884	25,000
1880	13,141	1885	38,466
1881	31,254	1886	46,693
1882	41,200	1887	50,471
1883	805		
Total			247,972

THE GRAND RAPIDS IRON CO.

is an organization formed during the close of the present year, 1887, for the purpose of operating the property which joins the Milwaukee on the west and heretofore known as the Wheeling mine. The officers are L. H. Withey, Pres.; H. R. Durkee, V. P.; J. C. Holt, Sec. and Treas., all of Grand Rapids, Mich. The property was held by Messrs. J. Q. Adams, Jas. F. Foley and Ed. Anthony, of Negaunee, who sold it for the sum of \$30,000; though as the transaction was made through the medium of a Chicago mining agency it cost the present owners \$60,000, one-half of this sum cash and one one-half stock of the Co.

However, it is not a bad bargain for the new company, since for the small amount of work that has been done the mine is looking finely. The old shaft was 180 feet deep. The new company has sunk it to 220'-40' deeper and has drifted south 120 feet and west 50 feet, and has cut through three different deposits of ore, which have respectively widths of 30 feet, 25 feet and 28 feet. In the new level, 220 feet down, they have drifted west 190 feet from the shaft and east to the Milwaukee line 80 feet. Of this distance 180 feet is through ore. The ore dips south but inclines also to the west. The quality is the same as that of the ore from the Milwaukee mine, well up in iron and nearly low enough in phosphorus to be Bessemer. They have also begun to

sink a new shaft, located 210 feet west of the old one. The necessity for doing this arises from the fact that the old shaft is deemed insecure and is likely to give way. This new shaft is made to dip S. 55° with the horizon and will be sunk 285 feet, and it is expected that this depth will be reached by July next. They will rise up in it from below. They have a hoisting plant with two Rochester drums $4\frac{1}{2}$ feet diameter. The company mined 1,100 tons, taken from the drifts, and expects to secure a good product in 1888.

The work is in charge of Mr. Henry Warner, of Marquette, a gentleman of recognized business and mining ability.

THE ROLLING MILL MINE

is east of the Milwaukee and is owned wholly or mainly by Mr. Luther Beecher, of Detroit. His son, George L. Beecher, resides at the mine; 1,058 tons of ore were shipped in 1887, and in the aggregate the mine has produced 228,461 tons; all since 1871.

The others of the south side hematite at Negaunee have all been idle during the past year; but going east of the city we have a new series of mines of which the first mention was made in my last report.

The most prominent of these is the

BUFFALO MINE

in the N. W. 4, S. E. 4 sec. 5, T. 47, R. 26, which has been held and operated the present company just one year. The mine is now all underground and reached by two shafts which are in separate deposits of ore, which latter I have examined and find to be of good dimensions. No. 1 shaft is the easterly one, it is 135 feet deep and sunk in the foot wall. The ore is reached through a cross-cut from the shaft and is opened east 92 feet into the open pit. The width of the ore is about 40 feet, and it is a clean body of ore; west of the cross-cut the opening extends 45 feet, and the ore maintains its full width. In fact the breast of the drift towards No. 2 shaft is ore. I discovered no indications of the ore narrowing.

No. 2 shaft is about 325 feet west of the former; it is also in the foot wall through which this cross-cut to the ore that west of the shaft is 45 feet wide and is opened a length of 120 feet, the breast of the drift west being still in ore. East of the cross-cut the ore is at first narrow, but widens out so that at the east end it is 60 feet wide.

The shafts require skips and also that the surface apertures be covered with comfortable framed structures. At the time I was last at the mine, Dec. 20, 1887, there were 37 men employed and the work for the coming year had

not been decided upon. Capt. McGregor was expecting orders to sink the shafts and to open up for the seasons stoping. At least double the last year's product can be obtained the coming year. There are two 4' drums and a 60 horse power engine. The mine has yielded as follows:

The officers are John Paulson, President, Minn.; C. A. Avery, Sec., Milwaukee, Wis.; Chas. McGregor, Supt., Negaunee, Mich.

THE SOUTH BUFFALO MINING COMPANY

holds the 40 next south of the preceding, that is, its estate is the S. W. 1 of S. E. 1, Sec. 5, 47, 23. The land belongs to the Pioneer and the Arctic Iron Co.'s and is held on a lease by the South Buffalo Co., in consideration that it pays a royalty on the ore mined of 25 cents for all sales, at a price of not above \$3.00 per ton, and for all sold in excess of that price the royalty to be 30 cents per ton. The number of shares is fixed at 40,000, par value \$25. The company began in April last to sink a shaft, which is now 125 feet in depth. Its location is 300' from the east line, and midway between this shaft and the line they have begun to sink No. 2 shaft; it is east 150 feet and north 60 feet from No. 1 to get into foot wall. The mine is in the N. W. corner of the 40. The first level is at 90 feet, and it is opened a length of 250 feet south and west, and they are still in ore going east; but west it is mixed. The ore attains a width of 90 feet at the cross-cut. The shaft is in the hanging wall, but a seam of ore 4 feet wide was cut in sinking it, at half way down. The ore is banded, hematite and soft ore, with a belt of hard jasper, about 5 feet wide running through it.

An output of 30,000 tons can be made next season if they desire to do so. New machinery will be required, and also suitable buildings. They mined and shipped the past season 4,914 tons of ore. The officers are Wm. F. Anderson, President; Chas. Sudbury, Secretary and Treasurer.

Joining the South Buffalo on the west is

THE SWAN EXPLORATION,

where they are sinking a shaft which December 20, was 125 feet deep in ore and rock. They have engine, boiler, hoisting drum and pump, are working ten men.

The work is undertaken by Mr. E. J. Swan, of Minneapolis, Minn. Andrew Gullgren has charge of the work. It is the S. E. \(\frac{1}{4}\) of S. W. \(\frac{1}{4}\), Sec. 5, 47, 26.

Joining the Swan on the west is

THE KAUFMANN

option, where they are operating a diamond drill. It is the S. W. $\frac{1}{4}$ of S. W. $\frac{1}{4}$, Sec. 5, 47, 26, and is called the Blue mine.

North of the Swan and west of the Buffalo, in the E. $\frac{3}{4}$ of the N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$ of Sec. 5, is

THE GEORGE MITCHELL

exploration. Mr. Mitchell has a plant of machinery and has sunk 75 feet and is drifting to discover ore.

Still west, adjoining the Mitchell, is

THE LUCKY STAR,

though on what ground it is deserving of an appellation that is evidently intended to suggest the possession of unlimited quantities of ore, I am not informed.

Going east from the Buffalo we arrive at

THE DELAWARE AND LACKAWANNA MINE,

formerly the Sam. Mitchell, Section 5. It was sold last spring to the D. & L. Coal & Iron Co., which corporation worked the mine the past season.

It is reported that the ore is all worked out and that the company will abandon the property. In Dec. last when I was at the mine it was full of water and all work had been suspended. I judge that the company has made no effort to find more ore; it simply worked out what was already in sight and at the close of the shipping season suspended work. During the two seasons since the mine was discovered, it has yielded as follows:

1886 8	3,823	tons
1887	3,411	66
	7,234	66

THE PIONEER,

which it will be remembered is contiguous with the foregoing, is also worked out and shut down.

It afforded in 1886, 5,140 tons, and in 1887, 1,203 tons.

It is one of the Iron Cliff Co.'s mines.

In the same section in which are found all the foregoing mines is also

THE NEGAUNEE

in the center of the N.W. \(\frac{1}{4}\) of Sec. 5, 47, 26. It is the only one of the mines in Section 5 that has Bessemer ore; the ore in all the others is non-Bessemer.

But then it ought to be good ore, for certainly there has been a world of trouble and expense in getting to it.

No hematite mine in the country has involved so great an expense to open as this one.

The ore is identical with the Cambria and probably in a continuation of the Teal Lake range, while the Buffalo, etc., half a mile to the south, are probably in the range with the South Jackson and its associated hematite mines.

The work of sinking a shaft on this property was begun two years ago the 7th of last July, so that two and a half years have been consumed in accomplishing this difficult enterprise. Two shafts were started, but only one has been completed. It is $432\frac{1}{2}$ feet from the surface to bottom, vertically down. It was begun 12'x12' in size, but was reduced to 10'x10' inside the timbers; the hoist is a single cage. The difficulty in sinking this shaft arose from the fact that the situation is in a swampy ravine and that they had to penetrate, before reaching the ledge, 105 feet of drift deposit, quicksand, etc., thus making it one of the most difficult undertakings of the kind that has ever been accomplished in the iron region.

Capt. Newcome states that they are raising 850,000 gallons of water each 24 hours.

No. 2 shaft is 500 feet distant in a northwesterly direction from the former and is 200 feet deep.

No. 1 shaft is north of the ore, and the cross-cut at the bottom to reach it is 30 feet. This drift is continued south horizontally 90 feet, where it strikes the foot wall.

The drift rises southeasterly in the ore about 100 feet, and is still in it; in fact, no doubt the ore continues to rise to the sand. East and west they have drifted 300 feet, 150 feet each way, and have some rock at both extremes.

The rise of the foot wall is at an angle of 24°, and it is the intention to locate a test pit on the surface at a point in the line where the ore may be expected to reach the sand.

In the mine eight rooms have been started, to run north and south, to be 20 feet across, leaving 20 feet of ore between for pillars. It is thought that the rooms will not have to be timbered, that the ore has sufficient stability to stand without such aid. They will continue to rise up from the shaft along the foot wall, which is apparently smooth and regular—hard, compact jasper. Measured at right angles with the foot wall the ore body is about 30 feet or 35 feet wide.

So far there has not been a man seriously injured since work began at the mine. About 100 men are at present employed—Dec. 20.

The ore is of the best hematite, about 65% and upwards in metallic iron and .037% in phoephorus. They are now hoisting 102 cars per day.

Capt. Albert Newcome, the chief local officer, has been in this employ since the first blow was struck.

They have made a new brick boiler house; 5,359 tons of ore were shipped in 1887.

Capt. Sam. Mitchell, General Agent, Negaunee, Mich. West from Negaunee is the Teal Lake range. We first arrive at

THE HARTFORD,

which is the name assumed by the parties who purchased the property known as the Ben Neely exploration, comprising workings in the E. ½ of lot 5 and lots 6 and 7 in section 35, T. 47, R. 27, being on the east end of Teal Lake, on the south margin. It lies next east of the Cambria mine; in fact a pit from which Mr. Neely had mined several hundred tons of fine ore, was found to belong to the Cambria when the lines came to be properly adjusted. There has been considerable exploring done on the property and good ore found at several points, and where they are now working, about 850 feet from the west line and 450 feet from the south line, they have good ore in sufficient quantity to insure a mine.

Two thousand tons were taken from the deposit found by Mr. Neely on the west line; this was secured, however, by the Cambria Co. So far as they have explored at this west end they did not find any continuation of this body of ore on the Hartford property. They sunk to the depth of 90 feet, and drifted some — were in rich ground—jasper, but no clean ore.

The main working shaft is about 60 feet deep, and the ground has been proved to the west and north of it sufficiently to enable them to know that they have a good body of ore. It seems to me that they are not deep enough down to determine much yet. There are a good many shallow test pits; some deeper sinking would be in order.

A fine plant of machinery has been procured in the past summer, consisting of new steel boiler, two Merritt drums, each 5 feet diameter; all working in a new engine house.

I went over this property carefully some months ago and examined all the pits, and again visited it in December. I found many favorable indications for ore, and also concluded that the mine will have a place in the shipping list next year.

Some of the officers are, S. R. Bell, Sec., Milwaukee; A. V. H. Carpenter, Treas. and Vice President, Milwaukee; Ben. Neely, General Manager, Negaunee, Mich.

THE CAMBRIA MINE

still holds its own and promises as well as ever it did, though the mine is in a different place from what it formerly was. They are now working over to the north, and the long axis of the main ore body seems to lie north and south; formerly it was east and west. The old ore pockets lay in regular succession in that direction.

No. 1 shaft which was sunk three years ago north of the then workings, is now 360 feet deep; 100 feet of which distance having been added in the last year. From the bottom they have drifted south 200 feet, cutting through lean ore; expect to reach in this drift some ore that was cut with the drill from old No. 1 pit. At 400 feet northwest from No. 1 they have sunk a new shaft, which is at this date, Dec. 23, 250 feet deep. The two are connected in the 2d, 3d, 4th levels, and nearly so in the 5th also. That is the drift from No. 1 in the 5th level is under No. 2 shaft and they have started to rise and connect. These drifts between the shafts are all in ore, which is mined and hoisted in both shafts. In addition they have drifted from No. 2 shaft north 120 feet, in the third level, all in ore. This ore runs directly north; it is in places 45 feet wide; they have roomed out in it preparatory to stoping. It is found to contain from 61% to 64% metallic iron and to be within the Bessemer limit in phosphorus. It is also pretty hard for Cambria ore; more like the ore found in the Negaunee mine, three miles to the east of this.

The mine is in far better shape than it was a year ago. Now they can tell where the ore is to come from and how to get it; a year ago the mine at No. 1 had crushed in and the ore itself became somewhat a matter of conjecture. They are just now engaged in opening work and are employing 75 men.

There are in stock at the mine 15,000 tons of ore. In the north shaft they followed a stringer of ore west 130 feet, and it has opened into a breast of ore 18 feet wide. The shaft was begun the 5th of last March and it has yielded 20,000 tons of ore; it is $5\frac{1}{2}'x9\frac{1}{2}'$ lateral dimensions, inside the timbers and will soon be to the 5th level. The dip of the ore is west, so that the bottom of the shaft is in the foot wall—shaft being vertical. The mine will easily afford its usual product.

Mr. A. Maitland, Negaunee, General Manager; J. B. Jeffrey, Supt. The Cambria has produced as follows:

Year.	Tons.	Year.	Tons.
876	6,324	1882	47,54
877	10,082	1883	47,50
878	3,754	1884	59,74
879	6,860	1885	50,79
880	7,232	1886	59,40
881	18,837	1887	41,18

THE LILLIE MINE '

is under the same management as the Cambria, and is but a short distance west of it. The Lillie has turned out to be a good mine, a good investment no doubt for Mr. Barnum and the others who purchased it three years ago. The ore body, which has proved to be so favorable, lies south of the workings of the former company, and the new shaft was sunk to reach it. This shaft is 294 feet to the bottom level. The run of ore is 175 feet long, east and west, and has a maximum width of 75 feet. There are 10,000 tons of ore in stock now, December 23, and 23,031 tons were shipped the past season. Probably 30,000 tons can be readily produced the coming year if required.

There is a long stretch of ground held by this company lying north, between the mine and Teal lake, that has not been much explored. Just now they are doing some exploring in that direction. The estate consists of 70 acres in the N. E. ½ Sec. 35, T. 47, R. 27, and is owned, as is the Cambria, by the Teal Lake Iron Co., from whom the Tillie M'g. Co. holds on a lease. Statement of annual products:

Years.	Tons.	Years.	Tons.
1875	144	1882	28,22
1876	6,801	1883	2,17
1877	10,127	1884	2,68
1878	8,506	1885	70
1879	21,681	1886	3,95
1880	18,347	1887	23,04
1881	16,718		

Wm. H. Barnum, Pres.; A. Maitland, Gen'l Ag't; Charles Koch, Supt. Continuing west and passing the Cleveland Hematite, which will be described elsewhere, we reach next

THE DETROIT MINE,

which had a very doleful experience last spring, but which is in most excellent shape at present. It will be remembered that the shaft is near the east line of the property and that it descends vertically 245', thence inclines to the south at an angle of 45° until it attains a depth of 350 feet. The old mine extended to the west line, 80 rods, and the ore is non-Bessemer. A boring was made to the south which discovered a body of Bessemer and a drift from the shaft made to reach it.

When this drift intersected the ore there was such a sudden influx of water that the mine became completely filled, and its removal was the occasion of considerable delay and of difficulty.

The drift is 500 feet long from the vertical line of the shaft and rises about 1" to a foot to the south. The depth below datum where the ore is struck is 342 feet.

At the depth of 221 feet another cross-cut to this ore has been started from the shaft.

The ore body inclines down to the west. The extreme limit of the working is south from the shaft 630 feet, but the ore is crossed by several drifts and shows a width of 90 to 100 feet. It is not probably so wide as this, estimating clean ore; but apparently there is a pretty good width. The length east and west seems to be about 300 feet. It is difficult at this writing, Dec. 23, to state only approximately the dimensions of the ore, even so far as it is opened. They have worked east by a series of rises until in this way they have come out to the surface, rising up in the ore and following up on the rock. The slope of this inclined foot wall down to the west is about 45°. They are preparing to make this rise into a skip road.

The ore is light and dry. The following are several analyses of this ore:

No. 1. by Joliet Steel Co.—

2.00 -, 0, 00		
M	letallic iron	61.40%
P	hos	.049%
Si	ilica	5.58%
M	Ianganese	0.55%
S	ulphur	0.09%
No. 2, by Rat	ttle, Nye & Co.—	
Iı	ron	61.10%
S	ilica	7.41%
P	hos	.045%
M	langanese	.371%
A	lumina	1.71%

No. 3, by same—

Iron	32.55%
Silica	5.71%
Phos	.067%
Manganese	.411%
Alumina	1.44%

The following is the annual product of the Detroit mine:

Year.	Tons.	Year.	Tons.
1882	5,402 12,314 3,098	1885 1886 1887	19,755 36,066 22,656
Total			102,291

Lee Burt, Gen'l Manager and Sales Agent, Detroit, Mich.; W.J. Officer, Supt., Ishpeming.

A shaft was begun south of the new find, but has lately been abandoned.

THE CLEVELAND MINING COMPANY

has something new in the way of improvement every year. The most conspicuous additions to arrest the attention that have been recently made, are the new shaft house at No. 2, and the new pumping engine house at the same shaft. The building is 100"x30', brick walls inside, and the outward walls and roof covered with corrugated iron. The pumping machinery is placed upon the most substantial foundation, pump 14"x9', engine, Corliss 18"x60", iron bobs, will raise the water from the bottom 560 feet by three lifts. This will make three separate pumping plants on this location, and the three tall brick chimneys are conspicuous objects. The Cleveland Co. makes everything with a view to its efficiency and permanency. The new pumping plant has cost \$40,000.

The several pits look certainly as well as they did a year ago. The Moro and Hematite even better.

Starting with the Incline pit, formerly one of the largest mines in the state, it has gradually become of greatly diminished value. This mine is 1,310 feet in length east and west, and an extreme depth below datum of 300 feet; its general depth in the west part is about 240 feet. At the west end is an underground skip road of 450' long, then a tram of 420 feet, thence a skip-way up to the surface of 490'. The ore now obtained in this mine comes from between the old levels and along the south side.

No. 2 pit, which lies parallel with the former and north of it, is also opened at the east end and is longer and deeper, having a maximum depth of 540 feet. The bottom is poor, mixed ore and jasper, but in the 390 feet level a turn to the north recently has given a large stope of ore. They designate it as the magnetic stope. It carries considerable carbonate of lime and some magnetite, and is sold as Scotch ore.

They are also stoping in this pit all along the south line between the levels. The two mines are about 70 feet to 100 feet apart; at one point, however, the No. 2 has come under the Incline, but is 300 feet below it. The vertical shaft is 180 feet to the knuckle where is the old skip road. In passing through the old openings they have built a pillar of masonry on the east side of the shaft 25 feet wide, with an arch over the old skip road. On the north of the old skip road they will rob the ore pillars—between the skip road and the north line. Connection will be made between the two pits sometime, for safety and to take the ore from the Incline to the new downright shaft, thus saving the long haul now made to take the product from the Incline pit to the surface.

No. 2 mine has an abundance of ore, but it is not generally first-class.

The Moro is in several lenses, but they seem to be working together. They show as a whole in the ground plan a circular form.

Last year the working was all at the north of the shaft to the west end of the mine, and it was looking finely when I was last under ground. Now the work is all south and east. Of the two long cross-cuts to the south ore they are working in the upper one around to the east and north, and will soon be at the shaft, with the east stope circling around east and north from the south lense.

The first cross-cut south at 296 feet depth, 280 feet long; second cross-cut, depth 248 feet, length 240 feet; third at 247 below datum, 80 feet long; fourth cross-cut, 70 feet long. The first and second cross-cuts reach the same ore, but the latter also cuts an intermediate lense in which they are now also working, driving east and slightly north, and will come into the ore that is mining in the level of No. 1 drift. A drill hole shows this body of ore to go down below the level of No. 2 drift. Nos. 3 and 4 drifts are in Nos. 6 and 7 levels respectively, and in the same body of ore. In the 6th level they have opened a length of 300 feet, with a width of 20 feet and upwards. In one place it is 40 feet wide. In addition to this they have in the 6th level a circular deposit 150 feet long, 10' to 18' wide, lying south of the main deposit behind a body of soap rock.

They are still working west in ore, going towards a drill hole, which at 389 feet from surface came to ore and continued in No. 1 ore for 24 feet.

The drift in direction of this ore is 370 feet down. On the whole the mine is showing first-rate, good for 50,000 tons of ore the coming year.

They are engaged in no dead work now, but have many stopes to work. The greatest depth is 570 feet. Shaft, downright, 305 feet, then to west down at angle of 45°.

Considerable interest attaches to the new work begun at Lake Angeline.

The Cleveland Co. owns the land bordering the east part of the lake, and last winter advantage was taken of the season by placing a machine on the ice and exploring with the drill the rock underlying the lake.

Five holes were bored, so distributed as to cover considerable surface area. The record of these holes is as follows:

L—32 feet water, 20 feet soil, 83 feet ore, which analyzed 45%, 39%, 57. 85%; and in phosphorus, .0263%, .027%; silica, 3.39 to 8.55%; Manganese 1.31 to 8.18%. The total depth of hole 116 feet; ore, red hematite.

M-37 feet water, $44\frac{1}{2}$ feet soil; 115.7 feet paint rock, 48.2 feet hematite ore.

Analyses of which gave 35.55%, 64.38%, and phosphorus .067%, .080%. N-Water 37 feet, soil 38 feet, jasper 56 feet, paint and soap rock 110.3 feet.

O-Water 33 feet, soil 47.6 feet, ore 20.3 feet. Analyzed 59.57%, phosphorus, 0.70%, paint rock 10 feet, ore 19.6 feet. Analyzed 60.32%, phosphorus, .184%, soap rock 63 feet, diorite 47.2 feet.

P—Water 37 feet, soil 42 feet, jasper 16 feet, lean ore 100 feet, paint rock 15.7 feet, ore 31.2 feet. Analyzed 57.6%, iron, phosphorus .051%, 54.16% and 59.31, iron, phosphorus, .062%. Then paint rock 3 feet, ore 48 feet; still in ore when drill was taken out.

To reach this body of ore a shaft is sinking from the north side of the lake, inclining downward to the south at an angle of 50°. It is, of course, well made, 5'x18' inside the timbers, and at this date, Dec. 10, is 180 feet long; it will be continued to 200 feet, when they will cross-cut south to the ore.

N—Hole is not far from the 16th corner, and P. is south of it. N. M. P. I. form the corners of a rectangle, of which the two first connect the north side. O. is to the east. The line of the shaft is about midway between M. and N.

East from the shaft to where the east line crosses the lake is 1,500 feet. The ore is identical with that of the Lake Superior mine hematite, of which it seems to be the continuation. In sinking the shaft power drills are used, the air being brought over the hill in pipe from the mine.

The small hard ore pit that was opened east of the mine, close to what is now called the East New York, is still worked and affords a small amount of ore. I cannot see that it is likely to be of much importance.

Mr. F. P. Mills, the new superintendent, succeeded Capt. Bacon in July last, the latter gentleman having been placed in charge of the celebrated Minnesota mine. Mr. Mills, though young, has had a large experience and a thorough theoretical education. He was formerly the mining engineer at the Cleveland, and assistant to Capt. Bacon; and subsequently General Manager for the Briar Hill Coal & Iron Co. of their mining interests in Michigan, comprising the Iron River and Youngstown mines, etc.

For the past two years he has been in Chicago, Assistant Manager in the Union Steel Co., so that his experience has been important and varied, and in all his several vocations he has shown great energy and skill; thus he comes back to the Cleveland to occupy the chief position, a place he is well qualified to fill.

THE CLEVELAND HEMATITE

mine is in the Teal Lake iron range, a mile north of the Incline, etc., pits. The mine has greatly improved lately, that is the deposit of ore has been found to be larger than it appeared to be a year ago.

During the summer it was thought that the mine was rapidly approaching exhaustion; that the pumps would be soon pulled out and the mine abandoned. The deposit had diminished to lateral dimensions of 25 feet; but on sinking a winze 100 feet in the ore and drifting from the bottom of it, it was found that the ore body expanded in size and was at this greater depth 100x 112 feet, with still appearances of greater length. The misfortune is that the ore is so far away from the shaft. The latter is vertical and is 440 feet north of the ore at the 500 feet level, increasing in distance away with the increase in depth, so that at 600 feet down the cross-cut will be about 550 feet long. It is very hard rock, costs \$15 to \$182 per foot to drive in.

They have delayed the matter of sinking the shaft further and driving the long cross-cut, first to explore the ore deposit to find if it would pay, under the circumstances, to attempt to mine it further, and then also it was a matter of uncertainty as to the expediency of continuing the present shaft or of sinking a new one. It was concluded to lower the old shaft another lift and the work of doing this and of driving the cross-cut has just been commenced.

The mine is fully equipped with mining plant, new duplex Knowls pump, compressor, &c.

The Cleveland Hematite has been given a prominence through the method of mining early adopted to obtain the ore. This plan has been fully described in my Report for 1885, with some modifications given in the last report.

Capt. Geo. Williams who had been long in charge of the work at the Hematite, accompanied Supt. Bacon, as did also Capt. James Williams of the

hard ore mines, to Minnesota. Capt. John Eddy is now in charge and has about 80 men at work; he is familiar with the mine and with the method of mining followed.

At the hard ore mine the mining captain is Harry Mills; both of these new officers are locally well and favorably known.

I noticed at the mines several things that seemed to be excellent plans to adopt: one is a new way for sending coal down into the Incline pit for the use of the forge that is maintained there, in a box shute from the surface. It is much easier and more expeditious than sending it down in the skip. Another simple scheme is, running the oil down in all the pits directly from the surface through iron pipes; the oil runs directly from the barrels down into the tanks in the mines. Formerly the barrel of oil was loaded into the skip and run down and when empty returned to the surface, but frequently the barrels were destroyed; now of course they are all saved and sold for \$1.00 each.

Another simple thing I noticed that is a matter of economy and is effectual; formerly it was necessary to keep a fire down in the Moro pit to warm the sticks of giant powder and for the men to warm their coffee at dinner. Mr. Mills tried turning the exhaust pipe from the pumping engine, at the Moro, down the shaft to the bottom, and is found to afford all the heat that is desired, and saves coal, etc.

The officers of the Cleveland Co. are: S. L. Mather, president, Cleveland, Ohio; Fred A. Morse, secretary; F. P. Mills, superintendent, Ishpeming, Mich.

The Cleveland Co. has shipped annually as follows:

Year.	Tons.	Year.	Tons.
854	3,000	1871	142,658
855	1,444	1872	151,724
856	6,343	1873	133,265
857	13,201	1874	105,855
858	7,909	1875	129,881
859	15,787	1876	145,661
860	40,041	1877	151,554
861	11,794	1878	143,320
862	40,364	1879	113,108
863	46,842	1880	187,234
864	49,954	1881	197,843
865	33,355	1882	204,341
866	42,680	1883	218,219
867	75,864	1884	224,479
868	102,112	1885	218,632
869	106,133	1886	203,386
	133,884	1887	204,828

THE LAKE SUPERIOR IRON CO.

has no striking developments, made lately. It has simply sent out a larger product the past year than ever before and the mines are in condition to duplicate the output the coming season.

The new find west of the Lake Angeline mine produced 900 tons of ore and they are developing it with the view to a much larger yield. There is no doubt of their finding ore, ultimately, in quantity at this point.

At a depth of 275 feet they drifted south 22 feet, 18 feet of which was ore; in this body they drifted east 45 feet, and the breast is still ore. It was here that the 900 tons product was obtained. The shaft has been sunk to 305 feet, at which depth a drift south found ore at 8 feet which, however, cut out in a few feet. At this date, December 15, the drift is in rock but it is thought it is but a "horse," since the diamond drill, further south, passed through ore. At a point 129 feet down in this shaft 7 holes were bored to test the ground. The shaft is in the dolerite dike described in a previous report. The company has erected a stone engine house at this shaft. The ore is the best hard specular Bessemer.

The Hematite mine is one of the best in the State. One of the largest and cleanest deposits of hematite ore.

The bottom is the 444 feet level, that is its depth below the datum of the main engine house floor.

It has been extended east to within 250 feet of the margin of Lake Angeline and the drift is still ore.

There are two deposits in this direction, the north one 15 feet wide and the south one 30 feet, the latter 210 feet from the water. A drill hole 40 feet above this level was made through the intervening ground to under the lake, but no ore was cut. The length of the mine in the 340 feet level is 1,400 feet, and the bearing of the axis is S. 60° E. and for a hematite mine it shows considerable regularity; the drifts are generally parallel and so are the headings. The ore lies in a syndinal which now at the bottom gives a width of ore in the widest part of 350 feet, foot wall to foot wall.

The headings or rooms are filled with rock and sand as fast as the ore is removed. Their method of mining differs from that of a similar kind practiced elsewhere, but it is found to work admirably.

As I have fully described it in my last report I will not repeat the details. Two pillars were mined out in the west end of this mine and no difficulty whatever was experienced.

The mine extends now east of the new shaft 375 feet, but the great body of the ore is between the two shafts, No. 1 and the new cage shaft, which are distant about 600 feet. It will be seen that the mine has not increased any in depth, it was the same depth last year as now; in fact they went to the bottom and then began to work up. So that ultimately the ore will all be taken out and the mine filled up with rock.

The ore is continuous through the mine, but at the cage shaft there is an up-lift in the rock beneath the ore, the ore going on over it, but the drifts go through it. To insure entire safety the company, in the past year, has resorted to the plan of cutting drifts in the foot wall, in the south side, 40 feet in from the ore. These have been made in the 340 and in the 400 foot levels east from No. 1 shaft. There is a shaft for rock and timber on the north side between the other two.

The rock for filling is taken from the old open pit situated south of No. 1. It is drawn down through winzes into the shutes in the different levels as required. Thence by tram cars it goes to its final destination. There is plenty of loose rock in the open pit that has been hoisted from the hard ore mine, but just now enough rock is taken from the rock drifts. The rock and timber shaft is at the 340 foot level and will soon be at 400 foot, and they are driving in the 444 foot level to come under it and then rise up, and thus carry the shaft to the bottom of the mine.

No. 2 mine, as intimated in my last report, has not been sunk any during

the year. It was then as now, at the 720 foot level, and presents no new features. They have explored with diamond drill in all directions and find nothing to warrant the continuance of the shaft. It is not expected that it will ever be sunk any deeper. In the stopes in all the levels a good deal of jasper is met with. They appear about as they have for a few years past, nothing new or encouraging. The work in all is in the west end, except in the 680, which has stopes at both ends. They are taking out ore in all the nine levels from the 400 down, and still have good stopes in some, even if they are smaller and less clean than they used to be. For instance in the 500 foot level the stope in west one is 30 feet wide; and in the 680 it is 18 feet wide.

In the bottom a horizontal drill hole running with the formation N. 70°, W. 710 feet long cut in the aggregate 198 feet of fine slate ore. The average of the analyses gives 65.60% metallic iron, and .060% phos. The last 41 feet gave 65.4% iron, .049% phos.

They have decided to drive to this ore, following the drill hole. After passing through 275 feet of rock they will reach ore. A second hole from some point also to the west, but angling a little more to the north than the former, also intersected considerable ore, some of the bodies corresponding with those in the first. The ore in No. 2 is first-class, hard, specular slate-ore; it averages about 66% in iron, and .100% in phos.

No. 3 shaft has been sunk an additional level; it is now at the 520, but it has not been much opened. A drift 100 feet west, cut a deposit of ore, which corresponds with one worked in the level above. The bottom and two other levels are all that are worked in this mine and those in the west ends; they are the 417 and 480 foot levels, both in the old No. 3 Barnum mine vein. The former is very near the north line. The ore is about the same in quality as the No. 2 mine ore; averages 66.2% iron, .120% phos. It is a little higher in phosphorus than that from No. 2.

The company is now exploring with the drill to determine if it will be policy to sink the shaft any deeper, a matter that seems likely to be decided in the negative. In mining they break about 10% of rock, and the product is one-fifth to one-third second class.

No. 7 is so nearly exhausted that it does not pay for working. The bottom is to the 520 foot level, one level having been added in the past year. The ore body in the bottom is about 100 feet long and 6' to 8' wide, having narrowed from a width of 20 feet, which it held in the 480 foot level. If sunk 200 feet deeper the shaft would be in the level of the ore found with the drill west from the bottom of No. 2. It is thought that they may decide to sink to the 720 level and drive east to this ore. At 200 feet is a body of it 42' one.

dimension. Nos. 2 and 7 would thus be connected, and if the ore between proves to be of magnitude a good mine will result, and will be drained from one shaft.

A-shaft is barren at present, no ore is coming out, and it is not known to a certainty if there be any more to come. The shaft is to the 3d level; the 1st and 2d are exhausted. The ore was 10 to 15 feet wide, and 215 feet long—the north lense.

It is uncertain how it will prove in the 3d level; the ground is much broken and irregular. First level is 287 feet below datum, 2d, 327 do.; 3d, 467 feet do.

There is ore still in the open pit, and a good deal of A-shaft ore has come from the open pit; but now the west wall of the pit, which holds the ore is close to the margin of the street, and if the ore is taken some plan must be resorted to besides open cut work.

For a description of the situation of this and the other shafts, I must refer to previous reports.

In Sec. 21, T. 47, R 27, at 850 feet east of the Lowthian mine shaft, an old exploring pit was cleared out and at a depth of 35 feet a ledge of clean, soft ore was reached into which the shaft was sunk 24 feet. At the bottom a drift north 20 feet was mainly in ore which averaged on analysis 63.3% metallic iron and .039 % phosphorus.

A drift east 30 feet at the bottom of the shaft, is all the way in clean ore and the end also ore.

The shaft sunk on Sec. 3 just west of the Detroit mine did not pan out well. Its depth is 96 feet, and some drifting done from the bottom, but nothing of value obtained. The work was abandoned in September last.

A new set of compressors has been added during the past year.

The company's officers remain as heretofore.

Jos. S. Fay, Jr., Treas., Boston, Mass. H. C. Hall, Agt., Ishpeming, Mich. W. H. Johnson, Supt., Ishpeming, Mich. H. B. Sturtevant, Mining Engineer. John Mc Entee, Capt. Hard Ore Mine. James Trebelcock, Capt. Hematite Mine.

Lake Superior mine yearly products:

Year.	Tons.	Year.	Tons.
1858	4,658	1873	158,428
1859	24,668	1874	104,311
1860	33,015	1875	119,368
1861	25,145	1876	110,570
1862	37,704	1877.	127,349
1863	78,976	1878	104,674
1864	86,773	1879	174,747
1865	50,201	1880	204,094
1866	68,002	1881	252,238
1867	114,935	1882	296,504
1868	105,745	1883	200,799
1869	125,560	1884	204,796
1870	166,582	1885	226,040
1871	158,074	1886	268,035
1872	145,070	1887	302,909

The product of 1887 is made up as follows:

77 . 3		1	BT.	4	11 2 001
Hara	ore,	tons,	, 140	. 1	115,931
				1, A shaft ore	
66	66	66	66	Section 16	840
Sumr	nit or	e, N	o. 1,	No. 7 shaft	16,047
Essex	ore.				- 30,766
No. t	ons h	nard	ore.		184,892
Hema	atite.			****	118,017
ŋ	Cotal.				302.909

THE BARNUM

presents no new features; they are working west along the Lake Superior Co.'s line and get annually about the same amount of ore; in 1887 it was 18,123 tons. It is good ore, No. 1, first-class specular non-Bessemer.

THE CLIFF SHAFT,

to the north, under the same management and belonging to the same company, is a far greater mine. It is a well equipped, first-class, hard ore mine in every particular except in the ore, which does not average first-class.

The shafts are near the ridge of the hill, which slopes to the south to the

valley, and are designated as A and B, the latter being the westerly one and being 420 feet deep. A, the east shaft, is 472 feet deep and is the main one. Both are vertical, are two cage shafts and are 835 feet apart. They are connected by a main drift from the bottom of A shaft.

The mine is in a synclinal fold of the formation, so that in places they are working against two foot walls.

The shafts are north of the bottom of the fold. The upturn in the fold of the rock is run both in the roof and in the floor of ore.

87,346 tons of ore were raised in 1887, mostly from A shaft; it is expected to mine 100,000 in 1888. The stopes are all what are termed breast stopes, no underhand nor back stoping in the mine. B shaft was got in readiness for hoisting ore in March last and now furnishes about 25 % of the ore of the mine. The workings have not been extended east beyond where they were a year ago; they are already nearly as far east as the Nelson house, having a length from B shaft east of 1,400 feet.

The mine has a fine pumping plant—two 14" plungers in A and two 20" and 14" plungers in B shaft. The former raise 240 gallons per minute and the latter 600. One man has charge of the pumps, it is his business to attend to them night and day, as required.

A new boiler house has been built, stone walls and iron roof. Its dimensions are 112 feet by 66 feet, and is to contain all the boilers. There will be 10 boilers, five in each set; one set will be as a reserve. The five new ones will be $5' \times 16'$; the old ones are $5' \times 14'$.

It is also the intention to have a new hoisting plant, two 10 feet Merrittedrums. The old ones limit the hoisting, they are inadequate.

The Barnum and Cliff are among the mines of the Iron Cliff Co. The Cliff and Barnum have produced each year as follows:

Year.	Tons.	Year.	Tons.
1868	14,386	1878	26,680
1869	37,503	1879	24,911
1870	44,793	1880	24,921
1871	45,939	1881	27,281
1872	38,381	1882	41,424
1873	44,368	1883	62,752
1874	40,255	1884	67,782
1875	40,914	1885	47,458
1876	37,750	1886	82,686
1877	38,314	1887	95,586

Wm. Sedgwick, Superintendent, Ishpeming, Mich.; Tom. Barge, Clerk, Ishpeming, Mich.; Alex. Maitland, General Manager, Negaunee, Mich.

THE YORK MINING CO.

is the name of the corporation organized a few years ago to operate the New York mine. The mine has been idle several years. I have heretofore described it with sufficient fullness. There was shipped from the mine the past year 5,556 tons of ore. This ore was mined several years ago and there still remains a considerable quantity on hand.

August Beerling, Superintendent, Ishpeming, Mich.; J. McCloskey, Agent.

THE EAST NEW YORK MINE

is a new enterprise in the city of Ishpeming. The parties who are conducting this undertaking found workable ore in the bluff adjoining the old New York and Cleveland mines. The outlook for a mine is thought to be promising. When I saw the location last they were sinking a shaft north from the ore preparatory to drive south and cut it at some depth below the distance they had worked in it. They were erecting an engine house and had secured a new plant of machinery for hoisting, pumping, etc.

Capt. W. H. Johnson of the L. S. Co., superintends the work; C. R. Ely, Secretary.

There is nothing especially new at the

PITTSBURGH AND LAKE ANGELINE MINE.

I went through it about the 8th of December, and found an abundance of ore of the best quality and excellent provision made for taking it out.

It so happened that they were not hoisting; the delay being occasioned by reason of the hoisting machinery being out of line and they were engaged in putting it right. The mine has a fine stone engine house, built but a few years ago, and an excellent, new plant of hoisting machinery.

At the time the building was placed it was thought that the foundations were laid in secure ground.

But in hematite ore deposits it is impossible to tell what direction the ore may take, and while they have not allowed the engine house to be undermined they have caved a portion of the mine southwest of the engine house, and as the northeast side of this cavity is pretty straight up and down, it has caused the ground to settle, "to draw," as it is said. Possibly in time it may necessitate the moving of the building.

The mine has 3 shafts A, B, C. B is in the foot wall side, inclining down north. A is somewhat centrally located, on the north side of the ore body.

The 1st level extends about 1000 feet east of A shaft to within 854 feet of the east line. The 6th level extends to within 1,164 feet of the line and the 7th is 1,335 feet away.

The sixth level has a length of 1,125 feet, while the 7th is only opened east. The second level is west of A shaft 520 feet. A cross section of the mine would show a curved bottom. The several lenses which compose the mine incline down to the west, lapping the one over the other, but separated by bars of rock. I have described these so fully in my last Report that I shall not do so now.

The method of mining has not varied, but they are getting the ore from the upper levels, taking out the pillars and letting in the ground. It is this ground that caused the disturbance of the engine house. In the fifth, sixth and seventh levels not much has been done except to run the opening drifts.

The last year's product has been largely obtained from the first, second third and fourth levels, taking some of the pillars. The bottom levels hold large resources of ore. The hard ore in the west part has not yet been much disturbed; they are getting into it, and all developments tend to show that there is a great store of wealth in this hard ore deposit.

A shaft is 464 feet deep. C shaft is 300 feet down. All double skip-shafts.

The ore continues to be of the same high grade. First-class averages 68% in iron and .025% in phosphorus; second-class, 60% in iron, phosphorus same as the first-class. They draw the line at .060%, all above that is classed as non-Bessemer.

The officers are, Alfred Kidder, General Agent; Thomas Walters, Superintendent; E. Z. Burns, Mining Engineer.

The yearly product of the mill has been as follows:

Years.	Tons.	Years.	Tons.
1864	19,500	1876	22,539
1865	20,151	1877	19,113
1866	24,073	1878	28,161
1867	46,607	1879	25,420
1868	26,651	1880	14,794
1869	39,644	1881	18,000
1870	53,467	1882	14,518
1871	33,645	1883	27,259
1872	35,221	1884	87,018
1873	43,933	1885	111,051
1874	30,499	1886	131,384
1875	30,281	1387	191,121

THE SALISBURY

is one of the Iron Cliff Co's. mines located adjacent to the Lake Angeline, being in the S. ½, S. W. ¼, of Sec. 15, T 47, R. 27. There is very little change in or about this mine, since I last saw it a year ago. The Salisbury is a good soft hematite mine and must be profitable to the company. Years ago the mining was all in the great open pit against the north line; now it is nearly all underground south of the former and reached by a single shaft, which descends from near the east end of the open pit.

I have heretofore described this shaft, which is peculiar, and also the deposit. The shaft is 420 feet long, reaching a vertical depth of 370 feet. The ore body is about 300 feet in length east and west and about 70 feet wide from foot wall to the jasper hanging; but it is not all clean ore; there are horses of rock in it which they generally manage to leave. At a depth of 270 feet below surface, is a drift in south 670 feet, which will be continued 200 feet more to the diorite. The purpose of the drift is to explore the ground; about 200 feet in width of lean ore were cut in the drift and some good ore; one deposit was 12 feet wide. A drift in this, however, 15 feet long came to the end of the ore.

The open pit and the underground workings are connected and some ore is brought up on the skip road that rests on the south wall of the open pit. There is also a drift east, 200 feet long to explore the ground. The ore body lengthens east and shortens west so that it just about holds its usual dimensions. The ore is all in one body now.

The officers remain as heretofore.

Alexander Maitland, General Manager; Thomas Buzzo, Mining Captain. The ore averages at about 60 % metallic iron and is close to the Bessemer limit.

The following table shows the yearly product:

Year.	Tons.	Year.	Tons.
1872	545	1880	22,387
1873	11,023	1881	41,888
1874	6,730	1882	42,019
1875	4,571	1883	17,028
1876	. 20,510	1884	23,171
1877	37,868	1885	29,503
1878	52,155	1886	51,231
1879	39,770	1887	49,229
Total			452,963

At about a mile and a half south and east of the Salisbury are

THE WINTHROP AND MITCHELL MINES,

now and for a few years past operated by the Winthrop Hematite Company as lessees of the Winthrop Iron Company, and of the Mitchell Mining Company, of these two contiguous mines.

These are working in the same deposit of ore. The line between the properties crosses through the main ore bodies and through the engine house of the Winthrop mine. The Mitchell lies east of the former, and its workings are nearly wholly underground.

There are three working shafts, the west one of which is designated as A shaft. It is the main shaft of the mine, the one that affords the most ore: is 350 feet in depth, inclining to the north. The Mitchell, being the deepest mine, takes the water of both of them, and there is a good deal of it. The pumping plant is placed west of the Winthrop, so that there is a line of 1,800 feet of rope to work the plungers.

The mines are not much deeper than they were a year ago, though 98,078 tons of ore have been removed in the meantime. There are 10,000 tons in stock now, December 16.

In looking over the formation at these two mines it would not seem that the possibilities for finding other equally good deposits of ore on the properties had been exhausted.

The St. Clair Bros., who control the mines, have recommenced to sink the downright shaft in the foot wall at west end of the Winthrop. This shaft

was made to a depth of 200 feet several years ago, and then discontinued; it will require to be sunk to a depth of 400 feet. When completed it will take the ore and they will be in a much more independent position as regards the matter of obtaining the ore. The Winthrop has been a fine deposit of ore from the first. It is always salable at a good relative price, and should have been a profitable mine; perhaps it has been, but a different system of mining would have made it more so. The trouble has been, it has been continued as an open pit to a great depth, and several serious "caves" have occurred when the ore was buried beneath a vast quantity of sand and rock that has taken much time to remove.

These "falls of ground" have occurred in the spring just when the company was in readiness to break the ore for the season's product. There is now a pile of this debris, 100,000 tons of ore mixed with dirt, which has been bought by Messrs. John Jones and others, who are shipping it to furnaces. There is market for it at low price, so that if freights are sufficiently moderate it can be handled at a profit. It is plain to see that when a mine is opened ready to stope the ore, to have it collapse is a serious matter in several ways, and to this disaster the owners of the Winthrop have been subjected more than once.

Both mines seem to be in unusually good shape now, and have a favorable outlook for the future. The local officers in charge are Geo. A. St. Clair, Superintendent Winthrop Hematite Co., Ishpeming, Mich.; Samuel Roberts, Capt. Winthrop Mine; Norick Anderson, Capt. Mitchell Mine.

The Mitchell mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1872	197	1880	12,78
1873	8,552	1881	20,9
1874	7,699	1882	33,39
1875		1883	• • • • • • • • • • • • • • • • • • • •
1876	5,596	1884	29,8
1877	3,897	1885	7,4
1878	4,259	1886	42,0
1879	11,450	1887	53,5
Total			241,6

The ore is non-Bessemer, but close to the limit.

The annual product of the Winthrop has been as follows:

Year.	Tons.	Year.	Tons.
1870	2,469	1879	27,05
1871	7,314	1880	45,24
1872	14,239	1881	43,90
1873	31,150	1882	23,25
1874	8,248	1883	50,14
1875	8,642	1884	53,07
1876	27,236	1885	63,91
1877	12,549	1886	44,27
1878	23,740	1887	44,486

I visited

THE FOSTER,

which is one of the oldest of the hematite mines, and which is in a pleasant, romantic locality. It is in Section 22, T. 47, R. 27, east of the Winthrop, in the estate of the Iron Cliff Co., by which corporation it has always been operated. The mine having been worked many years one would expect to find, what really does exist in fact, a large number of irregular open pits, which have been successively worked and abandoned. The mine is in high ground, in a wide hematite formation that is made up of lean ore, of jasper and ore with the occurrence of occasional pockets of ore that are sufficiently clean to pay to mine. It has never been high grade ore; it probably would not pay to mine and ship but it makes good foundry iron and is used constantly in the Pioneer furnaces at Negaunee.

The mining here for a year or two past has all been in a single pit, which is open to a depth of about 100 feet, when the skip road descends through the bottom to the north at an angle of 45°. The total length of this skip track from the surface to the bottom is 500 feet.

The bottom is ore; it is hard and firm, no timbers are necessary to hold up the ground. The pillars of ore amply suffice. The quality of the ore seems to improve in the bottom. It is richer in iron and holds less silica. It is said to average above 60% in iron now. An exploring shaft has been started in the low ground N. E. of the mine, and is 40 feet in depth, in lean ore. The product for 1887 was 7,876 tons, and the aggregate to the close of that year is 162,212 tons. Alexander Maitland, General Manager, Negaunee, Mich.

THE NONPAREIL,

formerly the St. Lawrence, was worked the past season for the first time in several years. All work was suspended some time ago, and I conclude, from conversation with Mr. John R. Wood, the General Manager of the mine, that it is a matter of uncertainty if it will be again resumed. The product is rather a lean, low grade ore. It was hoped, by those who took hold of the matter, that something better would be found. The mine is in the N. W. 4, Sec. 5, T. 47, R. 27, and is reached by a branch of the C. & N. W. R. R. The product for 1887 was 1,578 tons, thus making an aggregate production of 23,171 tons. The officers are: Sheppard Homens, President, New York; John R. Wood, Appleton, Wis., General Manager, etc.

THE DEXTER CONSOLIDATED MINING CO.

is a new organization effected to combine and operate the Dexter and Dey, two contiguous mines, the former being the E. $\frac{1}{2}$, N. E. $\frac{1}{4}$, and the latter the W. $\frac{1}{2}$, N. W. $\frac{1}{4}$ of sec. 3, T. 47, R. 28.

Sigmund Rothchilds, President, Detroit; F. O. Clark, Managing Director, Marquette, Mich.

There are two shafts, one in each mine, 200 feet apart, which descend to the north at an angle of 75°. The Dexter shaft—the west one—is about 300 feet long, 100 feet of which distance has been sunk in the past year by the new company. The Dey shaft is 150 feet deep on the incline. The shafts are in the quartzite foot wall.

The work formerly done was all between the two shafts, but the new company is working west of the Dexter shaft. I went through the mine Dec. 31 and examined the drifts carefully and found that they had cut some fine ore, both hematite and hard specular slate. Of the former there were two limited stopes, and of the latter, I found no stopes, but small bunches of excellent hard ore in the jasper. The hematite is far better than that formerly mined between the shafts, but there is not enough of it as yet.

A few hundred tons have been taken from the drifts. I find that this stock pile holds some rock mixed with the ore. It will require sorting when it is shipped. The company was working 30 men; it is hard, difficult ground to penetrate and with hand drills they cannot advance rapidly. It would seem to me to be better policy to discharge the men and explore with a diamond drill.

I was told that there is a deposit, 23 feet wide, of medium ore, east of the shaft, but as the stope was under water I did not see it.

The property is in a fine ore formation and further work may afford good results.

The two mines have yielded in all 24,539 tons. A new engine house was built last summer with two $4\frac{1}{2}$ feet Merritt drums in it.

West from the Dexter a few miles is

THE BOSTON MINE,

'80 acres, the S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$, and S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$, sec. 32, T. 48, R. 28, which the company owns in fee simple.

The Boston is a well equipped mine, having a first-class plant of mining machinery, including new Norwalk compressor. There are also about a dozen good dwelling houses on the property belonging to the company. The mine has been very fully described in previous reports, and, as there has no work been done in several years, there is nothing to add.

There is no better ore in the State than that in the Boston mine, high grade, Bessemer, slate ore. The mine is against the west line, where it has been worked for a length of 400 feet to a depth of about 200 feet. The ore deposit is very regular and has a width of 10 feet. The mine has produced a total of 61,715 tons.

THE AMERICAN MINE,

formerly at Sterling, adjoins the Boston on the west. It has also been idle until last summer when a new organization was made, an engine house built, a new plant of machinery procured, the mine pumped out and the work of sinking, drifting and stoping duly entered upon. The ore deposit is as yet not very wide—5 to 6 feet—but the ore is of the best, identical with that of the Boston. They are in the same deposit and the ore does not vary.

The shaft is 250 feet deep, it is supplied with skip, and still sinking.

The new machinery is Camp, Webster & Lane; two drums 4' diameter, and two steel boilers.

W. C. Reed, Superintendent; C. R. Ely, Secretary and Treasurer; W. H. Johnson, President, Ishpeming, Mich.

There were mined and shipped in 1887, 370 tons; making total output to date of 16,012 tons.

The company contemplates adding a compressor and power drills. There are 3,000 tons of ore in stock, which averages 66% in iron and .045% in phosphorus.

They are drifting west to reach the point, 490 feet distant, where the ore was found to be 19 feet wide.

Of the range of mines north of Champion and west of Lake Michigamme there is not much to be said. They have been described so many times in

previous reports and there has been so little work done since the first year in which they were opened, that they present no new features.

There are, however, a few new ones that it will be of interest to describe. The first of these is

THE NORTH CHAMPION IRON CO.,

organized Sept. 23, 1887, with a capital stock of \$1,000,000, having leased the E. $\frac{1}{2}$, N. E. $\frac{1}{4}$, Sec. 29, T. 48 N., R. 29 W., being a mile north of Champion station.

They have a vein of 40 feet wide, all merchantable ore, so far as opened. A shaft 7 feet x 7 feet has been sunk 83 feet in about the center of the south 40 and the ore tested to the west line of the property, showing it to be continuous. It has also been explored to the east. An engine house has been located south of the shaft on the hanging wall side, though there is a slight inclination from the vertical noticeable. The machinery consists of a boiler, hoisting engine, and a No. 7 Knowles pump.

An average of a stock pile of 1,500 tons sampled and analyzed by Mr. C. E. Wright gave metallic iron 57.96 %, phosphorus .156 %, silica 4.65 %. Other analyses of this ore of some forty samples from different pits, etc., are as follows:

Metallic	iron	59.01 %	Phos	.215	Silica	3.65
6.6	66	55.79 "	"	.181	66	5.45
66	66	56.92 "	66 ;	.178		6.65

Also the following analysis of a cargo sent to the Cleveland Rolling Mill Co., by Rattle & Nye:

Metallic iron	59.15
Phos.	.19
Silica	4.96
Sulphur	.081
Lime	.82
Manganese	.181
Magnesia	.57
Alumina	
Water and organic matter	7.07

They expect to mine all that can be sold in 1888. Product 1887, 883 tons; royalty, 25c per ton.

Officers—Henry C. Hart, President; Seymour Brownell, Secretary and General Manager.

In the same section is the

GIBSON MINE,

being the N. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 29, 48, 29. It is worked in an open pit, and 2,700 tons were shipped in 1887, making an aggregate of 16,357 tons to date.

Mat. Gibson, Superintendent, etc.

THE PHŒNIX IRON MINING CO.

now owns the Daliba, which is also in sec. 29, S. $\frac{1}{2}$, N. W. $\frac{1}{4}$, and N. $\frac{1}{2}$, S. W. $\frac{1}{4}$. Work was resumed in this mine in April last under the direction of Mr. Peter White, of Marquette, who holds the property.

The mine was freed of water and a small product of ore shipped—1,605 tons. The total production of the mine to date is 54,114 tons.

Full descriptions of this mine will be found in previous reports.

THE PASCO IRON CO.,

holding S. $\frac{1}{2}$, N. E. $\frac{1}{4}$. sec. 29, 48, 29, has not produced any ore the past year. The ore is of poorer quality than that found in some of the other mines of this range, as the North Champion, Wetmore, etc. It ranges at about 55% in iron and as high in phosphorus as any of them. Possibly a more extended development of the mine would result in obtaining better ore.

The mine has produced 58,667 tons.

D. H. Merritt, President.

THE WETMORE MINE,

west of Michigamme, is the same class of ore as those just described, but the ore deposit is free of rock; it is clean ore, and there is plenty of it. The following analysis, made by Mr. C. E. Wright, shows the quality of the ore. Iron 59.49%, phosphorus .139%, silica 5.52. Certainly if this is an average it is good ore, and as it can be mined cheaply there should be a profit in producing it. But money can only be made in mining such cheap ore by disposing of a large quantity of it. The product in 1887 was 3,335 tons.

In my last report will be found an extended description of this property, and, as the work subsequently has been mainly in the way of stripping, I find nothing more of interest to add. Total production to date 29,106 tons.

Ed. Wetmore, General Manager, etc.; Wm. D. Davis, Superintendent. Joining the Wetmore on the west is

THE WEBSTER MINE,

from which, at the time of my visit at the mine last year, I was told, a large product would be mined. This expectation has not been fulfilled, however, as the only work done was to send away a portion—2,054 tons—of the ore

already in stock. Perhaps the misfortune may have been that enough pains had not been taken in mining the ore to keep it clean—free of rock. The ore was mined on contract at 80 cents per ton, and I judged when I examined the pile, that it would require further sorting to make it merchantable.

The mine has a plant of machinery adequate for all mining work and there are a number of dwellings and other buildings on the property.

The total shipments to date amount to 14,668 tons.

Messrs. Watson and Palmer, of Marquette, control the mine.

West of the Webster, between it and the Beaufort, are three mining properties, which have been developed during the past year to a degree that they promise to become largely productive mines. The first is

FOWLE'S OPTION.

the S. $\frac{1}{2}$, S. W. $\frac{1}{4}$, Sec. 23, T. 48, R. 31, owned by the Michigan Iron and Land Co., and held on a lease by Mr. J. C. Fowle, of Michigamme, at a royalty of 30c on the ore.

Mr. Fowle has explored the land recently very systematically, by sinking two rows of test pits about 65 feet apart and parallel—the north row thought to be near the foot wall and the south one near the hanging. There are 7 pits in each row, which are at an average distance apart of about 80 feet, east and west. All these pits are in ore, clean ore, there is no rock intervening between the surface soil and the ore, and they have all been blasted in. Thus the explorations develop 600 feet in length and 60 feet in width of ore.

I went to all the pits and found no rock in the ore in any of them. Several analyses of samples made up of 80 to 100 separate pieces of ore gave:

Iron	56.82	Phos.	.148
Iron	57.40	Phos.	.26
Iron	60 %	Phos	.19

A branch railroad is graded to the property and it would be a simple matter to soon be in readiness to mine and ship ore.

Adjoining this on the west is

THE OHIO,

being the S. ½, S. E. ¼, Sec. 22, 48, 31, which also has been as thoroughly explored as is necessary before beginning systematic mining work.

The ground has been tested for a length of 400 feet west from the east line, showing a width of ore of 50 to 80 feet. Two shafts have been started, 300 feet apart, east and west of each other, on the foot wall side of the ore. The west one is 18' in the ledge, all ore. There is a dwelling house, shop, etc., on the land, and the railroad track is ready for the iron.

The ore analyzes at 55 to 60 % iron, .14 to .27 phos.

The exploring work has been done under the direction of J. C. Fowle, who acts as the company's agent.

The next property west is

THE NORWOOD,

which is in a more advanced state of development than the two preceding. The Norwood is the S. ½, S. W. ¼, Sec. 22, 48, 31, and has reached the dignity of a productive mine. Late in the season the railroad track was completed to the mine, and a cargo of ore was shipped. The development work has shown up a length of 600 feet of ore, and a width of perhaps 200 feet, at any rate there is a row of test pits, all in ore, across the formation, at one point between the shafts. Two shafts have been sunk, the west one about on the line between the two forties. It is 50 feet vertical to the ore, then inclines south, but the ore is both north and south of the shaft. They have gone east and west far enough to open two rooms each way from the shaft. This shaft was idle the last time I saw the mine—Dec. 20—and they were working in the east shaft, which also was 50 feet deep.

These three properties could be made to produce a good deal of ore. If properly managed the ore can be mined cheaply, and if largely worked, that is, if a large product is mined and sold, at even a low price, there can be money made.

But to mine a small product would be a losing business. The margin is too small and the preliminary outlay would be too great.

Mr. J. C. Foule, Michigamme, is the Agent.

Product, 1887, 2,200 tons.

The ore in these three properties is of the same quality.

West from the Norwood is

THE BEAUFORT MINE.

in the W $\frac{1}{2}$, N. W. $\frac{1}{4}$, sec 22, T 48, R. 31, which I found to be at the time of my last visit—Dec. 20—wholly idle; the mine full of water; no one working.

The families of most of the men still occupy the dwellings, but the men are at work elsewhere, mostly at the Ropes Gold mine, where the superintendent, — Williams, has also gone.

It is expected that the work will be resumed at this mine in the spring. I have described the mine pretty fully in my last report; it is wholly underground, the formation lying pretty flat to the south, having a width of opening of 600 feet and a depth on the lay of about 200 feet. The width of the ore at right angles to the walls is about 20 feet. The ore needs to be watched

so as to keep it free of rock. It is good ore when clean, but a lack of care in this respect results unfortunately.

It is not likely that this company has made much money; it has mined too little ore. The ore can be produced cheaply enough, but it sells at a low price, and the margin is small when all expenses are covered. The last season has been a particularly discouraging one by reason of the high lake freights that prevailed. It was expected to send out a greater amount of ore than usual; on the contrary a less product was secured. There was no market at a profit. Hon. S. S. Curry has relinquished the management of the mine, and Mr. M. Jenks, of Ishpeming, is acting as Agent.

What I have said of the Beaufort is equally applicable to

THE TITAN MINE,

which adjoins it on the west, and is under the same management. This mine is also idle and full of water. The two mines are nearly identical, quite so as to the ore and the manner of its occurrence. The ore in both mines is firm and hard. They are able to mine it out in large rooms and the pillars and roof stand well.

The Beaufort sent out in 1887, 12,829 tons, and the total to date is 89,566 tons.

The product of the Titan in 1887 was 16,003, and the total to date is 86,668 tons.

M. Jenks, Agent, Ishpeming, Mich.

THE SPURR MINE

continues idle. There is probably enough income derived from rent of houses to pay taxes, etc. The total production has been 164,941 tons. But west from the mine, in the same ore formation, on

SECTION 23,

T. 48, R. 31, the old Stewart mine, Mr. J. C. Fowle has discovered a fine vein of ore,—hard, blue granular ore, three samples of which taken at different times analyzed as follows:

No. 1—Iron	66.30	Phos	.290
No. 2—Iron	62.73	Made Dec. 3, 1887.	
No. 3—Iron	66.30	Phos.	.269

No. 1 specimen was taken from the deposit as uncovered in the foot wall of the old mine pit.

No. 2 at 75 feet west of old mine, where the vein in the test pit shows 8

feet wide, with 8 feet of earth over the ore and where they have sunk 8 feet into the ore.

No. 3 is from a test pit 50 feet west of No. 2. Still exploring Dec. 20, 1887.

THE MICHIGAMME MINE

shows no new features; it has produced pretty well the past year—51,975 tons of ore were shipped and the Superintendent estimates the amount in stock at 33,000 tons more. The mine is no deeper than it was a year ago and looks about as well.

The mine now is producing very little ore as good as that which used to be afforded in old No. 4 shaft. It is believed that No. 4 still has ore in the foot or hanging wall of the old deposit, since a diamond drill boring down from the bottom of the mine has shown this.

The mine is operated very economically, the ore having been produced at a total cost of \$2.26 per ton for the year. Mr. Fowle, the Superintendent, is a careful manager; he has held this position here for 12 years or upwards and the effects of his care are always apparent. It has always seemed, however, that back of him was a power that needed a little more enterprise. The push, which is not wanting in the local management, should be accorded to the ultimate directing powers of the company. The Michigamme Company is esteemed somewhat slow. The mine is in a formation rich in possibilities but there has not been very much expended to explore it.

When No. 4 pit was approaching exhaustion it would seem as if considerable effort were in order to discover an equally good lense to take its place. Some borings with the diamond drill were formerly made, which led to discoveries of ore that promise well but which no effort has been made to reach further.

The company has preferred to devote its surplus to dividends to opening up the mine.

The work now is mainly in the west end of the mine. The mine has been working west for several years in the direction of the old shafts, Nos. 5 and 6, which were for a long time abandoned but which now are worked again, not from the surface but by drifts extending west from the bottom of No. 4.

This underground work is west beyond No. 6 and far below old No. 6 shaft. It is thought to rise up and connect this shaft with the workings below and thus make use of No. 6 to hoist in again.

Of course this formation is a very hard one. It is expensive rock to sink and to drift in, thus making exploring costly work.

While the main stopes are in No. 5, still ore is obtained from all over the mine, between No. 3 and No. 6 shafts.

No. 4, the deepest shaft, has a length of 600 feet, and No. 5 is 450 feet deep, but the description I wrote of the mine one year ago is nearly as applicable now, and as I took a good deal of pains in examining the mine and in describing it at that time, I shall not dwell upon it now further than to say that I did not find anything new to note upon my recent visit. The mine looks neither better nor worse than it did last year.

Hon. Wm. H. Barnum, President; J. C. Fowle, Superintendent; Geo. Orr, M'g Capt.

The annual products have been as follows:

Year.	Tons.	Year.	Tons.
1872	141	1880	52,94
1873	28,966	1881	57,11
1874	45,218	1882	43,71
1875	44,756	1883	42,53
1876	20,074	1884	28,75
1877	28,238	1885	12,37
1878	58,622	1886	48,80
1879	56,935	1887	51,97
Total			567,86

The estate covers 1,400 acres of land.

THE CHAMPION

impresses one as a pretty big mine. I went through it recently—Dec. 16—and I found it to be quite a task, although I confined my observations to only parts of the mine. The openings are a good deal bigger than they used to be, but the stopes are not. A few years ago it was not much trouble to handle the Champion mine; it has always been rich ore; it has brought the highest market price, and there was an abundance of it always in sight. Great stopes of ore, 30, 40, 50 and 60 feet wide, clean, first-class, high grade ore. But the days of its glory have passed. They are contented with much smaller things now, and places in the mine that were neglected before are now looked to for ore and enables the mine to respond to the demands that are made upon it. In fact the mine produced the most ore last month—November—that it ever has in any one month before, 17,477 tons.

I first descended No. 6 shaft, which is 225 feet to the bottom. There are two skip roads to the third level; east of the shaft in third level they have

worked 125 feet. Apparently some more opening work must be done in this shaft. A pocket of ore in the bottom, which was 18 feet wide, seems to be worked out. There is not much ore in sight in the shaft. Ascending to the surface and going down No. 5, we find before leaving this pit that it contains a great deal of ore. As Capt. Cundy says, "No. 5 is a daisy." Stopping at the 8th level, 480 feet below the surface we make a hasty inspection.

They are driving west from the west end of the opening to find the ore which is worked in below, and which there, is 18 feet wide, and which it is believed extends upward to this level. East they have a stope of ore 15 feet wide.

In the 9th level the ore that was 12 feet wide is narrowing to about 9 feet, black and slate ore.

In 10th level, 600 feet down, dip 85°, 315 feet west of shaft, are boring with diamond drill to the south and west to explore the ground under No. 6.

East of shaft the ground is worked out.

In the 11th level the breast of ore is 218 feet west of shaft and is 12 feet wide; it will hold for 100 feet further still, perhaps get smaller. There is a length of ore of 180 feet long and 16 feet wide in this level. They are sinking a winze for another stope to work west. East is a drift into No. 4, but no ore.

The 12th level is the bottom of the skip road; have on the east side only a sump, but west they are drifting in rock to get to the ore; are in 30 feet and will reach the ore at about 50 feet more. The shaft is sunk to the 13th level but they have not opened out yet. No. 4 shaft is sunk to 20 feet below the 14th level. The shaft is 20 feet below the 15th—960 feet deep. They are opening out in the 15th and have ore near the shaft but not west of it in the south deposit. But in the north deposit, the hanging wall ore, they have a fine stope going west.

Are making a rock drift in the south lense to catch the ore.

In the 18th level in No. 3, they have worked out 260 feet west of shaft. The ore was 30 feet wide and is still so in the bottom of the level, which will be reached by rising stopes in the level below.

To the east in No. 4, 11th level, they have a new run of ore, which was found by extending the drift through rock 50 feet. The ore is 8 or 10 feet wide, and goes east under No. 2 shaft.

In No. 3, 14th level, the foot wall lense of ore is 20 feet wide, both stopes east and west. The north lense is 18 feet wide. The shaft is 20 feet below the 14th level.

In No. 3, 12th level, the ore is 18 to 20 feet wide, both east and west.

But it is useless to describe all the stopes in the mine. There are enough to assure a product the coming year of 125,000 to 150,000 tons of ore.

The mine is getting to be pretty deep, nearly 1,000 feet. The skip roads rest on the foot wall of the south lense and incline downward at an angle of 80° with the horizon. North of the shafts in the hanging wall is another lense of ore that is reached by cross-cuts from the shafts through the rock that separates the two deposits of ore. These deposits, which were formerly in the upper levels, wide and long, are now becoming much restricted in their dimensions, being narrower and shorter than heretofore.

They hoist ore from Nos. 3, 4, 5, 6 and 7 shafts. The three first named are in the main mine and are connected together underground; but 6 and 7 are separated from the rest and from each other.

The mine is so deep and the shafts so straight that it is a difficult task to ascend from the bottom.

To climb 900 feet of nearly vertical ladders is hard work for the men; to escape it they ride in the skips. But experience has shown this to be a dangerous proceeding; for instance, a few days after I was at the mine five men were ascending in a skip, when the skip got off the track and dumped; three of the men were in the skip and others were standing on the bail. The former were destroyed, the two latter succeeding in escaping with their lives. One jumped at a level and the other clung to rope and went up to the surface.

In the same manner three men were killed at the Cleveland mine a few months ago riding up in a skip that got off the track and dumped them down the shaft.

It so happened that I was once descending the ladders in a shaft when a skip passed me going up with a man riding in it. A moment later the man passed again, falling down the shaft. He had attempted to get out at the surface and had missed his footing, and so lost his life.

The Champion Co. has given so much evidence of interest in and care for its employees that I look to see it adopt some plan for sending the men down into the mine and bringing them out again that shall secure both their comfort and safety.

Heretofore in sinking winzes the company has used small hoisting machinery underground. These are to be done away with, an engine house has been made with a plant of machinery in it consisting of eight small drums for underground sinking, etc.

Everything on the surface is in admirable order, denoting the best of management.

The pit east of the East Champion that looked promising a year ago soon worked out; it proved to be shallow.

Products of Champion mine in previous years:

6,225	1878	
	10:0	73,764
21,535	1879	93,203
73,161	1880	112,410
67,588	1881	144,025
68,402	1882	157,516
72,782	1883	104,960
47,097	1884	208,156
56,877	1885	173,914
66,002	1886	137,598
70,883	1887	146,330
	67,588 68,402 72,782 47,097 56,877 66,002	67,588 1881

The officers are W. E. Stone, Treasurer, Boston, Mass.; A. Kidder, Agent, Marquette, Mich.; W. Fitch, Superintendent, Champion, Mich.; James Cundy, Mining Captain; Wm. Williams, Master Mechanic.

The Champion mine ore is all Bessemer but it is sorted, Mr. Kidder tells me, so that four grades are made of it; the first is about 68 % iron, the second 64 %, the third 61 %, fourth 58 %.

THE HUMBOLDT MINE

has developed nothing new that is of value. They are working only one shaft, No. 2, which is down 450 feet.

They have a single stope of ore south of the shaft, which is about 15 feet wide. Slate ore and very good clean ore, mainly first-class. The shaft is in ore now but has been for the last two lifts in rock.

The ore is working north again.

Off to the south, close to the highway and the Republic Branch Railroad, the company is boring with a diamond drill. They first encountered 70 feet of drift; are now—Dec. 16—in the ledge.

Considerable diamond drill work has been done on this property without much avail. I judge the present location of the drill to be a good one.

Not far away to the southwest, just over the line, the Excelsior Mining Co. is also boring with the drill; is now 40 feet down.

There is now, at the close of the year, but little ore in stock.

The formation presents many features of an encouraging character. The ore is hard specular, of good quality, but non-Bessemer.

J. B. Maas, Agent; Ed. Maas, Superintendent, Humboldt, Mich.; G. A. Garretson, Sec. and Treas., Cleveland, Ohio.

The Humboldt mine, including its predecessor, the old Washington, has produced annually as follows:

Year.	Tons.	Year.	Tons.
1865	4,782	1877	16,540
1866	15,150	1878	23,92
1867	25,440	1879	18,20
1868	37,757	1880	14,72
1869	58,462	1881	26,30
1870	79,712	1882	43,43
1871	48,725	1883	31,86
1872	38,841	1884	23,76
1873	38,014	1885	11,77
1874	27,890	1886	20,20
1875	9,642	1887	17,87
1876	3,333		

THE ARGYLE MINE

joins the Humboldt; it is an old mine, yielding specular slate and magnetic ore, but has never been a large one. The mine is near the Humboldt railroad station in the northerly hillside, which extends to the west. A pleasant location with many favorable indications for ore. It is adjacent to the old Washington mine, the Excelsior mine, etc., and thus is in a formation that was early explored in and mined in. But none of them were ever profitable; it is a very hard jasper formation, making it expensive to sink and drift in; and the lenses of ore that have been found and mined have proved to be small; the ore has cost too much. The formation in this hillside is full of ore pockets—small ones—so that when a deposit of ore is found, no matter how favorable it may appear, it must be regarded with suspicion until thorough development has demonstrated its value. The mine as formerly worked, is a succession of small lenses or pockets of ore lapping each other and separated by rock that also has to be cut away, thus making a good deal of dead work.

It is a good property to explore with a diamond drill, but such work should

be done thoroughly. There are two shafts, one of which, No. 2, is 500 feet in length, and No. 3, about 600 feet.

The mine has not been worked since 1883. One of the final pieces of work done was to sink a shaft near the $\frac{1}{8}$ post, midway in the south line. This shaft is but a few feet north from the one on the old Washington side of the line that was sunk years ago, and in which, it was claimed, was found a vein of slate ore that passed to the Argyle land. Capt. Cundy, who did this work, tells me that he sunk 50 feet and found the ore, and that there is a stope now west of the shaft 10 feet wide.

Much of the old mine has caved in, going down from the surface, and has thus exposed the foot wall in which at one point, has been found some slate ore, that has been exposed by cutting a trench south 75 feet long. This trench is on the ledge and shows most of the way fine slate ore, which has led to the claim of finding a body of ore 75 feet wide. At one other point, to the east, this same ore, or ore that is identical with it, has been tuched in the foot wall, by which also it is claimed that there is length as well as width in this alleged newly found ore body.

Close to the west shaft on the west side of it is a pit designated as the Bray pit, from which 700 tons of ore were mined two years ago, and still remains in a pile on the surface. The bottom of this pit still exposes the same deposit of ore. Also at a little distance west they have sunk a small pit in the foot wall, and the same kind of ore is found as in the Bray pit, and the conclusion is drawn that the ore extends all the way; in fact, that here also is a large body of ore. I should have stated that these "finds" have been recently made by Mr. D. M. Wadsworth and two other Ishpeming gentlemen, who have the property on an option, and who, it is reported, have just sold the mine for \$250,000, by which transaction they realize \$10,000 apiece. Certainly if the mine proves to be as good as it is claimed to be by a correspondent of the New York Engineering and Mining Journal, who places it ahead of any mine in the country, "excepting, perhaps, only the Republic," it is cheap enough at that price.

The owners are Detroit men. Hon. Don M. Dickinson, President; Sigmund Rothchild, Vice President. Since 1866 the mine has produced 256,-744 tons of ore.

THE REPUBLIC IRON CO.

has met with misfortune in the past year through the death of its able president and general manager, Mr. David Morgan. A year ago I accompanied him through the mine, the first time he had been underground for several years, and it proved to be his last before going to his final resting place.

I find nothing new to record in the Republic mine, but will briefly refer to the several pits in succession, commencing at the west end.

The Morgan pit has not been sunk any in the last year. The shaft had been lowered 120 feet, and two levels have been opened out. It is looking as well as it did a year ago at least.

In the two levels immediately above the bottom, there is in each, in the hanging wall, a fine stope of ore 15 feet wide, 30 feet long, slate ore.

The Pascoe pit looked poor when I went through it a year ago, but now the reverse is the case. It will afford 25 % more ore than it did last year.

There is one new stope, 18 feet wide, going off into the hanging wall, and there is also a 5 feet stope of black ore in the bottom.

The Morgan is the pump shaft—takes the water from the Ely and Pascoe pits.

Another lift has been added, 12" plunger 5' stroke.

The Ely has been sunk 60 feet, in jasper, but in the hanging wall is a fine vein of ore; altogether the pit about holds its own.

Gibson is no longer worked, but they are boring in the bottom to explore the ground between it and No. 1.

The latter shaft is about 1,060 feet down on the inclination of $50\frac{1}{2}^{\circ}$ with the horizon. The lowest level worked in it is the 1,000, the shaft is down 60 feet more. The main run of ore is 175 feet long, 7 or 8 feet wide; besides this is a loop of ore 15 feet wide that gives considerable addition to the product.

The encasing rock is soapstone, which underlies the quartzite and overlies the jasper.

No. 1 runs into No. 5, where they are mining out the ore pillars and filling in with rock; are now at this work in the 8th level; were working higher up last year.

No. 6 shaft comes down in rock and required besides a long horizontal drift to the ore, to avoid which they have sunk a shenel shaft; that is they make a horizontal run from the foot of the main shaft to the ore and then put down a skip road inclining 60°, following the pitch of the ore. The slate ore keeps along with the black and both pitch off to the northwest. They are separated by about 20 feet of soap rock.

The slate ore is 25 feet wide, with a working length of 100 feet. No. 6 will afford as much slate ore as last year but the black ore will be mainly in No. 7.

Both have been lowered another level and are now at about the same depth as No. 1. Capt. Pascoe has a finished chamber in No. 6. The roof is admirably arched; it distributes the pressure finely.

In No. 7 also is a shenel shaft, or there soon will be one. The shaft is too far from the ore and the introduction of an underground skip road has been decided upon. The same will be done in No. 8 also. Otherwise they must continue sinking in rock and drive 200 feet to the ore. In No. 6 it is run up on the skip track, trammed to the shaft and sent to the surface.

The product from No. 7 is largely black ore. The main lense is 300 feet long and forty feet wide; but it holds some rock, that is there are bunches of jasper, horses of it, the ore itself is free of it.

No. 8 is a lense of slate ore by itself, 200 feet long and 8 to 9 feet wide. The ore is 225 feet northwest of the shaft, necessitating that length of drift. They will not sink the shaft further but resort to the underground skip road. No. 9 will be taken by No. 8 soon.

Product of the several pits for the year 1887:

 Morgan
 33,197

 Pascoe
 11,686

 Ely
 16,248

 Gibson
 268

 Nos. 1, 5, 6
 99,255

 No. 7
 50,513

 No. 8
 18,950

 West Republic Scram
 153

 Total
 233,375

Chas. Hickox, President, Cleveland, Ohio; W. D. Rees, Secretary and Treasurer, Cleveland, Ohio; Geo. Wilson, Agent, Republic, Mich.; Peter Pascoe, Superintendent, Republic, Mich.

The product for each year has been as follows:

Year.	Tons.	Year.	Tons.
1872	11,625	1880	235,388
1873	105,435	1881	233,65
1874	122,639	1882	235,10
1875	114,726	1883	152,56
1876	120,045	1884	277,73
1877	165,836	1885	249,07
1878	176,221	1886	241,163
1879	135,131	1887	233,37
Total			2,784,20

Since the above was written the company has ordered of the Rand Drill Co. of New York, an air compressor 20"x48", also two Haxton steam boilers 6'x18'.

THE REPUBLIC REDUCTION CO.

is still experimenting; that is, it has not begun the work of separating the ore from the rock on a commercial scale yet. The work so far is esteemed favorable.

Peter Gottstein, General Agent, etc.

THE WEST REPUBLIC MINING CO.

has closed down the mine. The only work in progress when I was there—Dec. 5—was boring in the bottom of the mine. I was told that the stopes were all exhausted. This I can well believe, since it was plain to see that unless something new was found the end must soon come. In previous reports I have described the mine, and also such other facts, relating to explorations, etc., as are of any value. I need not repeat here.

The West Republic was opened in 1881, and since then has produced in all 122,125 tons. The product of 1887 was 12,777 tons.

A. C. Saunders, Sec., Cleveland, Ohio; J. O. St. Clair, Supt.

NEW EXPLORATIONS,

west of Republic and south of there, I have noted as follows: The St. Clair Bros. have a recent find of fine slate ore in the N. W. 4, sec. 35, 47, 30, three miles from Republic, opposite the Standard mine. Enough has not been done—Dec. 10— to make much estimate of its value. They have sunk 25 feet and are 5 feet in ore.

In section 28, E. $\frac{1}{2}$, S. E. $\frac{1}{4}$, T. 46, R. 33, Mr. J. C. Fowle and others have a find of hard[hematite of which several analyses have been made which give an average of 60.41% in iron, .080% phosphorus. Royalty 40 cents per ton.

Michael Gleason and others at Republic have explored in the N. $\frac{1}{2}$, S. E. $\frac{1}{4}$, sec. 19, 47, 30. Have two shafts, 146 feet deep. 50 feet of soil. In this they have a width of ore of 11 feet.

Three hundred feet from this is another shaft 125 feet deep, in which they have 8 feet of magnetic ore. Analysis gave iron 65.16%, phosphorus .035%. Royalty 30 to 50 cents. I have seen six analyses of this ore which gave in iron from 66 to 68%, and in phosphorus .024 to .069%.

One by Mr. C. E. Wright, gave iron 67.72, phosphorus .057.

Also in section 4, T. 44, R. 33, Capt Peter Pascoe is conducting an exploration which results favorably. Have ore 30 feet wide, 180 feet long, hard hematite. Analyzes above 60% in iron, but non-Bessemer. They are preparing to sink in it.

THE PITTSBURGH AND LAKE SUPERIOR IRON CO.,

has succeeded excellently well in the new mining work which it has had in progress for the past three years, and which I have described in the Commissioner's Reports for 1885 and 1886 with sufficient fullness. The vertical shaft, which was sinking a year ago is now in full working order and obviates the long underground tramming that was previously necessary.

I drove out to the mine a few days ago but unfortunately found it shut down for repairs to the compressor, and also the superintendent was away east, so I did not go through the mine, as has been my annual custom heretofore.

I found the company exploring near the highway east from the location. A shaft was sunk 60 feet, and they were drifting north, had hematite ore.

Jos. Kirkpatrick, Ager	at, Palmer, Mich.
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Year.	Tons.	Year.	Tons.
871	4,171	1880	38,59
872	34,495	1881	34,27
873	41,204	1882	40,59
874	16,106	1883	19,41
875	4,070	1884	11,74
876	15,324	1885	5,67
877	20,211	1886	24,03
878	4,704	1887	47,45
879	24,141		

THE WHEAT MINE

is looking well. The company's new "find" just north of the railroad, north of the deep open cut hematite pit, has turned out well. It proves to be a clean deposit of excellent ore.

There are two shafts about 60 feet apart, 70 feet deep. They are 40 feet in ore, which has a width of 25 feet and so far seems 100 feet long.

The dip is to the north 50° and also has a seeming pitch east of 35°. The ore analyzes 63% .040% Phos.

The officers are Daniel McGarry, President; Thomas Prout, Superintendent, Palmer, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1879	850	1884	6,82
1880	3,324	1885	9,20
1881	9,040	1886	15,85
1882	9,554	1887	17,53
1883	6,625		
Total	*******		82,02

THE SWANZY MINE

was operated for a time the past season; 2,842 tons of ore were shipped, making an aggregate production to date, which includes also the Cheshire, of 154,942 tons.

The Swanzy is in the S. W. 1, N. E. 1, Sec. 18, T. 45, R. 25. J. J. Pierce, Sharpesville, Pa., President; J. R. Wood, Superintendent, etc., Appleton, Wis.

THE HOME MINE

is an old property in Sec. 28, 47, 26, adjoining the Wheat mine. A small amount of exploring was done in 1886 resulting in a "find" of ore that enabled the parties who held the option and did the work to sell out. Nothing has since been done.

Adjoining it on the east is

THE ROYAL MINING CO.,

formerly the Gribben, being the S. ½, S. E. ¼, Sec. 28, 47, 26. G. E. Tarbell, President, Milwaukee; D. H. Merritt, Secretary and Treasurer, Marquette; J. F. Foley, Superintendent, etc.

The company has a shaft sunk to a depth of 60 feet, at the east end of an old open pit from which ore was mined years ago. They were driving a cross-cut to cut some ore that was found by the diamond drill boring made last spring; at the time of my visit to the mine the drift was in lean ore.

Adjoining this on the east is

THE RICHARDS LAND AND IRON CO.

Hugh Richards, Pres't, Milwaukee, Wis. The property is the N. W. 4, N. E. 4, Sec. 33, 47, 26.

The company has built an engine house, and put into it a fine duplex compressor, which has not yet been put to any trial.

There is a large open pit, which contains banded, flag ore; that is, the formation is made up of alternating bands of ore and jasper. The ore is good, and if care is taken to leave out the rock a merchantable product may be had, even if there is no profit in obtaining it.

Capt. Foley says he mined and shipped 400 tons from the Richards that was good ore. Subsequently a contract was let to mine by the ton, and the contractors sent nearly as much rock as ore. Naturally it failed to give satisfaction. The amount shipped in 1887 was 1,374 tons.

THE JOYCE EXPLORATION,

so called, lies north of the Royal, in the valley. Both the Richards and Royal are in the steep jasper bluff, which extends east and west and forms the most notable feature in the Cascade range.

THE MENOMINEE RANGE MINES.

Commencing at the east end of the range with the mines of the Penn Iron Co., I will describe them in succession to the west.

The mines of the Penn Co. are among the best in all respects. They yield a large product of ore of a quality that is in universal demand. They are excellently well equipped and well managed. It is plain to see that the affairs of the Penn Co. are at all points in proper hands.

THE EAST VULCAN

has been an expensive mine ever since it come into the possession of its present owners. Had it not yielded the best of ore, or had it been under poor management, it might have been permanently closed long ago; fortunately it is in good hands, and skill and care have compensated somewhat for the excessive requirements of the mine.

The company has just now undertaken [a course of expenditure that requires a long purse and good courage to carry through.

It will be remembered, perhaps, by those who are acquainted with the mine, or have read the descriptions given of it in previous reports, that No. 1, the chief producer of the mine, is a long chimney of ore that descended nearly vertically for 200 feet, when it declined to the west, so that at a vertical depth of 500 feet, the present length of the shaft, the ore is 425 feet away. At this point the floor of ore is in dimensions 110 feet by 90', and a diamond drill has been bored down into it a depth of 114 feet. As this ore body is dropping away to the west at an angle of 27° with the horizon, it will thus be at the 700 foot level upwards of 800 feet away from the shaft, making it necessary to

drift through the rock all that distance to reach the ore after the shaft was sunk.

This matter has been held under consideration during the past year, while no work has been done in the bottom of the mine. It was finally decided to sink a new shaft, which is already under way, 63 feet down from the surface—Jan. 18. The location of it is midway between the present No. 1 and No. 3 shafts, 800 feet from each. The shaft has three compartments, is 16' 1"x6' inside, 20'x9' outside measurement. The two end compartments are for the cages, the middle one, 6'x6', for pump, etc.

At the present depth of the shaft it will be intersected by a tunnel driven in from the south. The adit will be 261 feet long, and from the mouth a trestle has been built 489 feet long that is 40 feet above the railroad. The ore will all come out through the adit. Capt. Curnow has known skill in the work of sinking; his method is excellent, and his form of shaft, the arrangement of the timbers, etc., leave little, if anything, to be desired. It is sure to be an expensive operation, but the company, that must pay the bills, is fortunate in having Capt. Curnow to superintend the work.

They are driving from the mine to the shafts at the 227 feet, and the 500 feet levels. The first is within 125, and the latter to within 75 feet of the shaft. The two drifts, each 800 feet long, make 1,600 feet of length. These drifts are partly to explore the ground; they are not in the same vertical plane, the upper one being 126 feet south of the lower one, each in separate ore formations, with intervening soap rock.

Assuming the ore to continue in the same westerly pitch, the new shaft will intersect it at a depth of 775 feet; but they will drift east to it at 725 feet, at which depth there will be a back of ore of about 300 feet.

They are sinking with a simple Rochester hoist, but when completed the shaft will require a new plant of machinery. Capt. Curnow thinks he will have the shaft down in a year; if he does it will be extraordinary good work. I do not doubt but he will make every effort to accomplish it. It will be readily seen that this shaft, the long drifts and the necessary machinery, etc., will cost at least \$75,000 in cash, and more than a year's work,—all preliminary to reach a body of ore that by a freak of nature has dipped away from the shaft they already have.

While No. 1 was not sunk any deeper last 'year, it afforded a good deal of ore from the flat deposit that was found under the sandstone west of the shaft and which continued down to the bottom overlying the main deposit. The mine, however, above the present bottom, has been pretty well exhausted, and not much more can be expected of it until the new shaft is completed.

No. 3 mine, however, away up on the hill 800 feet to the west, is doing

finely. It is just a year since I visited the East Vulcan; they were then about in readiness to begin pumping out the water from No. 3. The mine had been idle since 1884, but it was known to have a floor of ore west of the shaft. And it was to mine this that the work was undertaken. The shaft was lowered 116 feet to the 300 foot level, and a drift made west, also a rise and a return drift to the shaft, but no ore was found. Fortunately, however, Capt. Curnow had drifted east (he has a habit of poking about with his drifts) 41 feet, and came into ore, which proved to be a body 90'x95', in lateral dimensions, clean ore; not a bit of rock in it. They stoped up in this ore 80 feet, when it lengthened northwest, as shown by a drift, to 125'.

The ore body diminished in size after the first few sets up; but the bottom is all ore and the indications are that it may continue to increase in size, downward. It is very fine blue ore, rich in iron but non-Bessemer. The shaft has been sunk 80 feet, or to the 400 feet level.

As in the new shaft at No. 1, they are driving an adit from the south at No. 3, which will intersect the shaft at 117' from the surface, and will be 425' long. The product will go out of this tunnel on to the trestle already built, 350 feet long and 45' above the railroad track. It is estimated that this arrangement will result in a saving of 14 cents per ton, which is the cost of running the ore down the incline 2,400 feet to the point where it is now discharged. The estimated product of No. 3 for 1888 is 33,000 tons.

No. 2, which is east from No. 1, has been sunk 100 feet, to the 351 feet level. The cage goes down as fast as the shaft is sunk. The buckets used in sinking are raised and lowered by being attached to the bottom of the cage. The cage goes up above the landing, carrying up the attached bucket filled with rock; a car is run in under, over the mouth of the shaft; the bucket is detached from the cage and rests on the car, whence it is trammed out to the dump and is so placed as to discharge its contents automatically.

There is nothing very promising about No. 2 mine. The known ore body is of contracted dimensions, but they will have now 100 feet of depth of it. The produce of East Vulcan in 1887 was 50,954 tons.

Capt. John Curnow, Superintendent; J. E. Hagey, General Manager P. I. Co.

THE CENTRAL VULCAN

is a new mine, which has been opened and worked the past year, producing 12,772 tons of 62 per cent Bessemer ore. It is in the side hill, east from the West Vulcan, at the site of the Co's. old saw mill, the old mill house being used for the machinery. The shaft—vertical cage—is 160 feet deep. There are two levels: 1st one 87 feet from surface and the ore was 20 feet wide and

120 feet long; but in the 2d its width has diminished one-half. So that it is estimated that from present appearances there may not be above 14,000 tons of ore in sight.

They are filling up all the rooms from which the ore has been taken by running down sand, etc., from the surface over the ore. All the openings will be filled and all the ore mined out.

Exploring drifts in the mine may lead to finding other pockets of ore. In fact a long drift in the bottom going east gives evidence that such a result may be looked for.

The work is directed by Capt. Roberts of the West Vulcan.

There is a long stretch of ground from the Central to the East Vulcan that seems favorable for the occurrence of ore; but as it is deeply covered with soil, exploration is slow and expensive.

THE WEST VULCAN MINE

holds its own admirably. It is 100 feet deeper than it was a year ago, and the magnitude and quality of the ore remain undiminished in value.

It is also one of the best equipped mines, in the matter of machinery, in the state. A new engine house has just been built on the level ground west of the new shaft, and in it is placed two sets of hoisting machinery, each consisting of two drums 12 feet in diameter. One set made by Webster, Camp & Lane, Akron, Ohio, the other by M. C. Bullock & Co., Chicago. The former, one engine 28"x48", and the latter, two engines, each 28"x60". Nothing can be finer, of the kind, than the foundations; 250 cords of sandstone masonry on which these ponderous drums and engines rest, besides 50 cords of the same are laid in the walls surrounding the foundations. With this new hoisting plant are two of Dean's steam condensing pumps. The latter are said to cause a saving of 25% in heat by reason of sending the steam into the cylinders in a condensed form.

The new machinery is all in place but is not yet connected to work.

Among other important improvements are eight new dwelling houses each 30x38, 2 stories; each house is designed for two families. They are well built, with cellar under all.

The West Vulcan has been gradually approaching the point when there would be a radical change in the method of mining, that is, hereafter the plan of filling the mine with rock as fast as the ore is removed will be alone followed.

It is already filled from the bottom level up, practically; there are a few pillars left, and when these are mined out the whole mine will be filled, and

hereafter the system of expensive timbering and ore pillars will be a thing of the past.

The downright shaft is in the hanging wall at the west end of the mine and is sunk to the 9th level, 670 feet down from the surface. No. 2 shaft is on the foot wall near the east end of the mine. The 8th level is fully opened but the 9th is only partially so; the cross-cut has been made to the ore from the downright and continued into the foot wall, where a drift has been cut east to No. 2 and on both ends of the ore. At each 100 feet of distance along this foot wall rock drift, cross-cuts have been made to the ore and "rises" made through the ore to the level above. These "rises"—winzes—are for running rock through for filling.

They will work each way in the ore from these cross drifts, taking it all out in a succession of horizontal sections, 7 feet high, and filling the space with rock as fast as the ore is removed. Capt. Roberts' plan is to work from the drift along the foot wall, taking about half the width of the ore, then in returning, stope the remainder and fill the whole space as fast as advance is made. When this section is exhausted they will rise up on top of the filling and mine out another section in the same manner and fill as before; thus in succession continuing to rise until the level above is reached. As they rise they will "carry up" the necessary winzes through which to run down the ore into the shutes in the main drift. Very little timber will be used. Mr. Hagey tells me that upwards of 2,000,000 feet of pine were used in the mine last year, besides 60,000 pieces of lagging, in all representing an expense of 37 cents per ton of ore mined.

The ore in the 8th level is 600 feet long and has an average width of 25 feet. In the 9th it seems likely to be larger, since at the east end it proves to be 35 feet wide, a considerable increase.

The downright shaft is giving some trouble; it is 10' x 16' inside and divided into 4 compartments. On the whole this plan of section proves to be a weak one, the pressure of the ground on the north side displaces the timbers and it is thought that if the other means fail to arrest the effects of this pressure they will make a "false rise," 15 feet north of the shaft, through the ground where the pressure is greatest.

The new machinery will operate the two cages and the timber way in this shaft and the skip in No. 2 shaft. The latter shaft has been heretofore in the foot wall and required a cross-cut to the ore; but the greater inclination of the shaft brings it constantly nearer the ore and now, in the 9th, it is just to the limit. I should have mentioned with the machinery a new duplex compressor—capacity 23 drills. These become necessary by reason of the long drifts in the foot wall now and to be hereafter made in each level.

The product of the West Vulcan, 1887, was 141,400 tons, an increase of 35,211 tons over the previous year. The ore is first class, Bessemer.

The Penn Co. made a fortunate investment recently in the purchase of the lease of the Curry mine, which joins the West Vulcan on the west. The former company had, previously to relinquishing the property, sunk a shaft 47 feet deep at the foot of the hill below the old mine, and had drifted south 30 feet. The Penn Co. pumped out this shaft and continued the drift 8 feet further and found a body of ore 14 feet wide; this they have proved extends east 125 feet, possibly much further.

At any rate at this distance away they are now sinking a shaft $5\frac{1}{2}'x5\frac{1}{2}'$ inside. The shaft has reached a depth of 60 feet, and is in ore on the hanging wall side. The purpose is to sink 100 feet and then mine out the ore and fill up with rock. This ore is the same as the West Vulcan south vein, and is in line with it. The old Curry is on the West Vulcan north vein.

The work is in charge of Capt. E. S. Roberts, Superintendent of the West Vulcan mine.

There are employed at West Vulcan 400 men.

The Vulcan mines were opened in 1877, and have yielded as follows:

Year.	Tons.	Year.	Tons.
1877	4,543	1883	79,874
1878	31,239	1884	101,729
1879	57,350	1885	124,120
1880	72,405	1886	143,930
1881	85,671	1887	205,127
1882.	94,042		

J. E. Hagey, General Manager, Penn Iron Mining Co.

Since writing the above I learn that Supt. Roberts has resigned, and the duties which he has so long and ably performed will hereafter devolve upon Capt. Wm. Bond, formerly of the Nanaimo, and Capt. John Oliver, of the Norway. The latter will have the general oversight of the work.

THE NORWAY MINE,

also, is undergoing a noticeable change especially in the east end, which is a broad underground mine, and is filling from the bottom up with sand and rock. From No. 5 east to the Perkins line, a distance of 700 feet and a width of 30 feet, the mine is all underground, 400 feet down to the 5th level, and will

be all filled. They are filling it now with all due rapidity. There are immense rooms in the mine; few formations admit of such large openings being made as exist in the Norway mine, and there are, of course, many pillars of ore, which can be attacked as soon as the rooms are filled. Through the filling have been left secure drifts leading to the pillars and stopes of ore.

This part of the mine is reached by two shafts, mainly, the downright or new shaft, sunk in the hanging, south of the mine, is 480 feet deep—100 feet below the 5th level. They are making a drift in the foot wall to extend east 500 feet from the shaft to the east line. All parts of the mine, at this end, can be reached from this drift. The mine is irregular by reason of the underlying limestone, which rolls and is a good deal contorted. The crosscut from the downright, north cuts through a point of limestone at 45 feet from the shaft, while the main foot wall, limestone, is reached at 205 feet north.

From No. 5 west to No. 9 750 feet, the mine is a deep, wide open chasm that in the west end has yet a fine stope of ore, 45 feet high, 27 feet wide, and in No. 9 are the great exposed ore pillars, which sustain the overlying sandstone. West from this point the mine is again underground, and is worked for 500 feet to No. 10, and shows a good deal of ore.

They estimate the product for No. 8 and No. 9 at 30,000 tons for 1888. It will easily reach that amount. The mine has continuous workings for a length, east and west, of 2,200 feet. It is a very peculiar mine, but I have described the formation, etc., in previous reports, and I do not think it necessary to enter into the matter now. It is one of the pleasantest mines to work in, in the whole country, easy of access, dry, airy and safe. The Norway is a favorite with all miners who have been employed in it. J. E. Hagey, General Manager, Penn Iron Co.; John Oliver, Superintendent; James Haskins, Assistant Superintendent.

The product of the Norway for each year is as follows:

Year.	Tons.	Year.	Tons.
1878	7,533	1883	114,836
1879	73,540	1884	71,515
1880	198,765	1885	57,741
1881	137,558	1886	93,878
1882	165,084	1887	95,558
Total			1,015,178

THE CYCLOPS MINE,

joining the Norway on the west, shows no new features. It produced more ore last year than was estimated, and perhaps the output in 1888 will equal that of 1887. There are a number of places from which ore is obtained and they are safe for a product of 10,000 tons and upwards. It is also one of the Penn Iron Co.'s mines and is superintended by Capt. Oliver.

J. E. Hagey, General Manager, Penn Iron Co.

The output in 1887 was 14,308 tons, and the aggregate to date, 1878-1887, is 245,784 tons.

THE QUINNESEC MINE

has been abandoned by the Penn Co. It obtained from the mine in 1887, 6,580 tons of ore, which makes all that they find to be profitable to take out.

Mr. Ed. Wetmore, who is one of the fee owners, is just now looking after the property, thinks there is still a good field for exploring in the Quinnesec mine.

The mine was opened in 1878 and has produced all told 281,299 tons.

The Penn Iron M'g Co. produced in 1887, from all its mines, $321,574\frac{1}{4}$ tons.

On Section 25, N. E. 4, S. E. 4, T. 45, R. 34, the company is still working, but with no very encouraging prospects. All the work since that described in my last report has been with diamond drill.

THE PERKINS,

for an abandoned mine, produces a good deal of ore-16,834 tons in 1887.

The mine is close to the Norway and was opened and worked from 1874 down to 1885, by the Saginaw M'g Co., when, having caved in badly, the mine was abandoned by the company, and was then taken hold of by Capt. John Perkins, the Superintendent, as a personal venture, with the result that he has since mined and sold 29,690 tons of ore.

This ore is derived mainly from the pillars that were left, that Capt. Perkins was enabled to reach by reason of the fact that the mine had all caved in and it was thus safe to mine the ore pillars. The ore has not been very expensive; there is no pumping to be done. The Norway, which is deeper, drains it.

But I described it all in my last report and I find nothing to add. There have been no new discoveries. Altogether the mine has yielded 359,620 tons of ore.

THE STEPHENSON MINE,

which I examined and described a year ago, has not been very actively pushed since.

The mine is in the foot wall of the Perkins and no ore body of much magnitude has ever been developed. At my recent visit to the locality I found the mine idle; during the year, however, the company sent out 3,589 tons of ore, making a total that the mine has produced of 39,602 tons.

The estate is N. W. 1, S. W. 1, Sec. 4, T. 39, R. 29.

H. G. Fisk, General Manager, Iron Mountain, Mich.

THE SMITH-BUTLER EXPLORATION,

so called, is one of the most promising of the new undertakings in the Menominee range.

A syndicate, comprising J. D. Butler, Angus Smith, J. N. Porter, Wm. H. Osborn, O. C. Davidson, H. J. Colwell, Byron White, secured the lease of of Sec. 8, except N. ½, N. W. ¼, and of the N. W. ¼, Sec. 9, in all 720 acres. This land embraces the Norway town site and the Briar Hill mine, etc. It is south of the Norway and Perkins mines, and in line with the South Vulcan, Central Vulcan, and the Curry new "find"—a mile east and west.

The syndicate began exploring with diamond drill several months ago, and met with excellent results. The first boring was made at 50 feet west from the line between Sections 8 and 9, in the N. E. \(\frac{1}{4}\), N. E. \(\frac{1}{4}\) of 8, and at midway of the 40, north and south. Ore was found at the depth of 271 feet. The drill continued in ore 24 feet, when it broke. A second boring was made 30 feet north, and 30 feet east of former, in which ore was found at the depth of 209 feet, and continued in it for 146 feet.

Analysis of ore at 249 feet, gave iron 59.10, phos. .019%.

At	270	feet	depth,	iron	68.85%	phos.	 .012
66	315	6.6	66	66	66.97	66	 .027
66	345	66	66 7	142' in ore, iron	65.52	66	 .033

They are sinking a shaft in the N. E. 4, N. E. 4, of Sec. 8, close to the west line on the foot wall side of the ore. The depth to the ledge is but 50 feet, but it is in wet ground, and thus, seemingly, endless difficulty is experienced in getting through this quicksand, etc. The shaft is, at this date, January 10, within a few feet of the ledge, but it has been at this point for some time.

Going west from Norway, there is nothing of importance in the way of mining, or of ore discovery until Iron Mountain is reached, where are found several mines, including the great bonanza,

THE CHAPIN MINE,

which is perhaps the best iron mine in the State; at any rate, it led all others in production last year, and it is pretty safe to conclude that it will do the same in the coming year. The Chapin mine has been, for a few years past, in a state of transition. That is, making a radical change of its entire system of mining. This work involved the sinking of new shafts, all in rock, that should be of adequate capacity for the entire operating of the mine; new plants of hoisting machinery, new ore pockets, new ore docks; the moving or destruction of all the buildings that were located over the mine; the grading of new side tracks, and the filling of the mine. At the same time, while this work was in progress, the product must be kept up.

Naturally, considerable trouble has been experienced to bring matters to the present systematic working.

The problem was an important one and one not easy to solve; it involved the expenditure of a vast deal of money and the exercise of great mining skill. However the end has been accomplished, the mine is harmoniously working in all its parts, on the new system. It is all simple enough too, now that it is in operation. The mine is in excellent shape. I have never been so well pleased with the Chapin as now. I have always detested that old system of timbered rooms and ore pillars, especially as applied in this mine. But that is done away with. The mine is filled now from bottom to top, with the exception of the necessary drifts, with sand and rock, and in the work of stoping, as fast as the ore is removed, rock is made to take its place.

There is no longer any danger of the stupendous "caves," the occurrence of which rendered necessary the filling of the mine and the abandonment of the old system. It is safe and economical.

A great part of the product, the past year, has been taken from the pillars, and the output for several years to come will be derived, in great measure, from the same source. Two years ago, when they began at these pillars, it was somewhat discouraging work and it seemed then that a good deal of the ore contained in them would be lost, but a modification of the method then pursued has secured better results. There is no ore lost now. They are sure of saving all the ore in the pillars except, possibly, where they were crushed and the ore mingled with surface dirt in the portions where the mine caved in. The removal of the pillars of ore was the most puzzling part of the problem. It is accomplished in this way: Where the shafts are in the hanging wall side of the ore, cross-cuts are made north to the opposite wall from the shafts and then main drifts cut along in the foot wall parallel to the ore; from this foot wall drift cross-cuts are made through the pillar south to

the hanging wall. A track is laid in this cross drift and a rise made through the ore to the level above.

Stoping is begun at the south end of the pillar, the whole width, 18 or 20 feet wide, is cut out to a height of 7 or 8 feet, and as rapidly as advance is made the space behind is filled with rock. The ore is run out in tram car to the main drift and thence to the shaft. As one horizontal section is cut out another drift is made through the ore, on top of the filling, to the hanging wall and a second section of ore taken out and the space filled with rock. And so on in succession the pillar is mined away by cutting out one horizontal section after another from the south to the north. As they rise up a "mill" is brought up through the filling that discharges the ore into cars in the main drift. The lower end of the mill is, of course, cut through the rock that separates the ore from the drift. The "mills" in this mine are circular in form of horizontal section, $2\frac{1}{2}$ diameter, and are made of blocks sawed to a pattern at the Co's. mill, so all difficulty in their construction is obviated. The rock for filling comes down through the winze in the ore and is drawn out by means of a shute into a car, as fast as it is required.

For greater convenience in reaching the pillars at the east end of the mine a temporary shaft has been made on the foot wall side. It will be seen that, now, as all the rooms are filled, and, as there are 600,000 to 800,000 tons of ore in the pillars, which are thus, virtually, in solid ground, there is scarcely no limit to the stoping that may be done. The mine is a large one, and the pillars may be attacked in all the levels.

The two vertical shafts, B and C, have been sunk 100 feet to the 7th level in the past year; but no stoping has been done below the 6th, which was well opened a year ago and still contains a good deal of ore.

The shafts are still in the limestone; B at the edge of it, while C is 40 feet south of the under edge of the limestone. This is due to the fact that the ore at B dips at an angle of 65', while at C the dip is 80°.

It has long been a question as to the proper position of this limestone belt with reference to the ore. Here it overlies the ore with great seeming regularity, while in the mines to the east, Quinnesec, Norway, etc., it is the foot wall rock. Is it thus the underlying or the overlying rock? In the Chapin mine is seen in the cross-cut from the shaft, north from B shaft, in the 3d level, a conglomerate underlying the limestone; the rock of which the conglomerate bed is made up is slate and limestone. The limestone boulders are the same rock that composes the overlying belt, thus indicating that the latter is the older formation, and properly belongs as a foot wall rock. But I will not attempt to discuss this geological problem at this time. Its conclusive settlement will be a matter of practical value. For instance, the

Emmett Mining Co., in sinking its shaft at the corner of the Chapin, expecting to intercept the Chapin deposit of ore in its underlay to the north, has gone on the supposition that the limestone here occupies its true position with reference to the ore; certainly if it is to turn and become the foot wall rock, the Emmett Co. has made a great mistake.

All the mine above the 5th level was opened on the old system, but in the 6th the plan of filling has been proceeded with from the first. In the west part of the mine, in the wider portion of the deposit, the method of proceeding is essentially the same as that pursued in mining the pillars. They cross the ore to the south with a broad drift—double track—and cut a tunnel in this foot wall rock parallel to the ore; at each 50 feet an ore-shute is made which ultimately receives the ore through the winze that is carried up as the stoping proceeds upward. The ground is thus marked off into blocks 50 feet wide.

A drift is made through each of these blocks of ore to the hanging wall and a rise is made through the ore to the level above. The rise is for the rock filling, dumped in from above. The stoping is begun at the farther side against the hanging wall, the full width of a block—50 feet—and carried south to the main tunnel. The ore is trammed to the cross-cuts where, being attached to a cable, they are drawn to the shaft. As fast as the ore is broken the space is filled up with rock, up to the back of ore. Just space enough is kept open between the wall of rock in the rear and the ore in front to suffice for the workmen. Slight modifications are seen in the different stopes due to change in the hanging wall or in the stability of the ore.

I was informed that the total mining cost by this method, which includes the cost of filling, supplies, etc., was 60 cents per ton of ore. The filling costs 15 cents per ton of ore. On the average they obtain five tons of ore to the man. It is proposed to cheapen the cost somewhat. They will do the filling by separate contracts, by other parties than do the stoping.

Sufficient filling material comes from the rock cuts in the mine, shaft sinking, winzes, and the long drifts in the foot wall. By weight one ton of the ore equals two and one-half tons of the rock. The ore shutes for milling down the ore are carried up as the successive horizontal sections are cut off. They connect with the main drift, as previously mentioned, and are so constructed as to hold a supply of ore that is drawn out into the tram cars. It also is made to contain a ladder way by which to reach the stope above.

In the east end of the mine there are portions of the ore lenses that are sufficiently narrow to admit of the stoping being done longitudinally with the ore body instead of transverse, as just described. The method is essentially the same, however. They simply carry the stopes east and west with the ore, and

fill up behind them with rock. There are some modifications according to circumstances; as a stope, corresponding to a drift, may be cut through transversely from the main foot wall drift, and then filled with rock and another one cut out, and so on. These drift stopes are 8'x9' in section, and any number of them may be proceeding at the same time. To facilitate the work in this longitudinal stoping a drift is made in the ore along the foot wall in each successive rise. The mills for sinking down the ore and for receiving the rock are kept in this ore drift.

When in full working it is expected that the tramming will be expeditious and systematic. The cars will be of capacity of two tons each and will go to and from the shafts by being attached to endless rope, one running in the 5th and one in the 6th level. The power is furnished by two horizontal compressed air Corliss engines, 12"x36", placed at C shaft in the 6th level. The empty cars go out on one track and the filled ones go in on another.

The particulars regarding the shafts and the machinery I have given in previous reports.

The sinking of the 3d shaft, D, has not proceeded further than to commence to sink the stand pipes for the freezing process that has been determined on. The location is in low, wet ground, where it is 98 feet to the ledge on the foot wall side, and 1,100 feet west of C, and 600 feet east of the west line.

They have at this date, February 1, 13 pipes down to the ledge. The pipes are 10" diameter and there will be 26 in all. The estimated time to complete this is till April 1. At present four shafts are used in hoisting, the one in addition to the three already mentioned being A, the pump shaft, which is 750 feet east of B. In addition is a timber shaft between B and C, vertical from surface to 6th level, in foot wall.

The officers of the Chapin M'g Co. are John H. Van Dyke, Vice Pres., office Milwaukee, Wis.; C. H. Cady, Supt., Iron Mountain, Mich.; Wm. Oliver, Mining Capt.; Per Larsson, Mining Eng., etc.

The annual product of the Chapin has been as follows:

Year.	Tons.	Year.	Tons.
1880	34,556	1884	290,865
1881	134,717	1885	177,978
1882	247,505	1886	198,871
1883	265,830	1887	334,026
Total	*****		1,684,348

Among the late improvements are a new machine shop 60'x100', forge shop 60'x80' and carpenter shop 40'x100', all in one structure 280' long; also a new laboratory.

So far as the 7th level has been explored the indications point to an increased size of the deposit. At B shaft the ore is 70 feet wide in 7th level, and also from the 5th to the 7th the levels have not shortened materially at east end, while they steadily lengthen at the west end.

The company is also building a new office 50'x40', nearly done.

THE MILLIE MINING CO.

is a new organization but an old mine, i. e., it is a new company that has taken hold of the Hewitt, which mine had been abandoned by its former proprietors.

So far the new company has been fortunate; it began work in June last, and sunk a pit 200 feet west of the old workings and immediately found a lense of fine ore. The shaft is 70 feet deep, and the ore body is 130 feet long with a maximum width of 16 feet. The royalty is 50 cents per ton and includes use of old machinery, etc. They claim that the ore is costing \$1.50 and is worth at the mine \$4.25. It is beautiful fix ore 67% iron, phos. .030%. Have 3,000 tons in stock, and Mr. Jones estimates product at 10,000 tons for 1888.

The officers are D. G. Dessau, President, N. Y.; Vice President, C. W. Kennedy; Secretary and Treasurer, F. Dessau, N. Y.; Superintendent, J. T. Jones, Iron Mountain.

The location of the mine is south of the Chapin, in the Chapin mine foot wall. There were shipped in 1887, 1,163 tons, making a total of 40,769 tons.

THE WALPOLE MINE

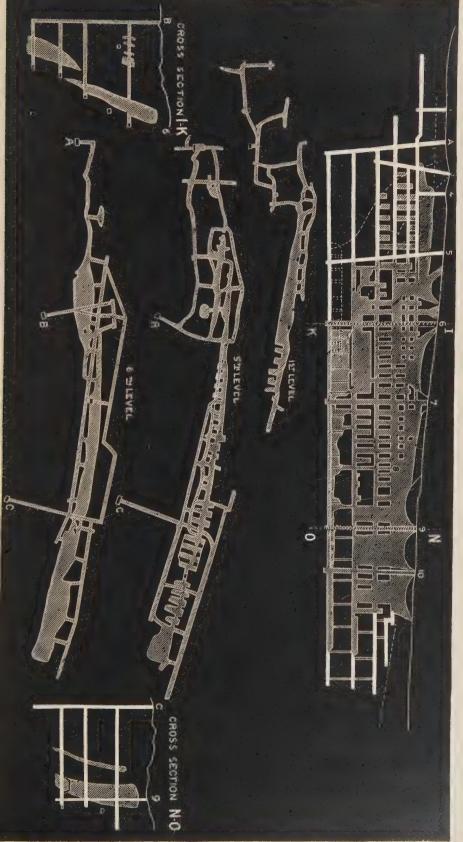
also joins the Chapin, being immediately east of it. A shaft has been sunk 270 feet deep, and 1,740 tons of ore got out. The property was formerly explored by the Menominee Mining Co.

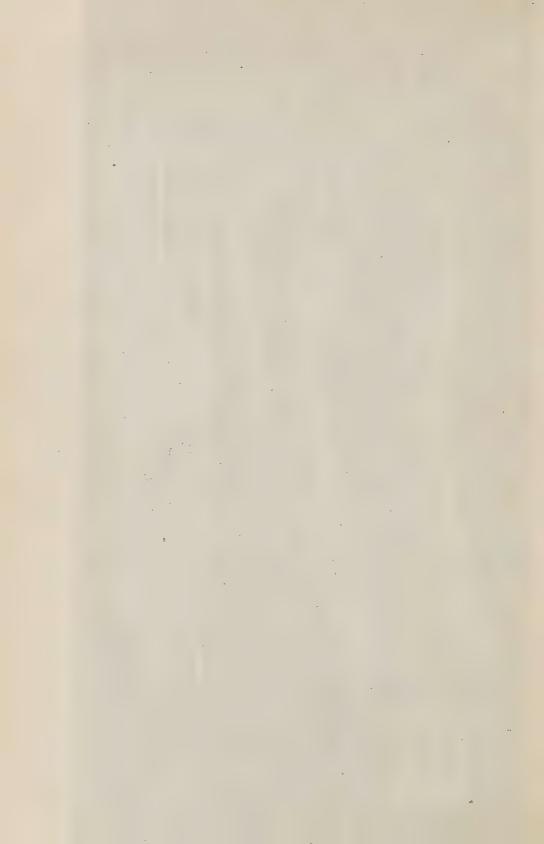
The present company is working thirty-five men, Dec. 3, under the direction of Capt. John Barker. I did not learn as they deemed the prospect of the mine very bright. The ore, so far as found, has proved narrow and irregular, about 6 feet wide in a winze in the bottom. It is good ore, but they do not find enough of it. The description of the property is E. ½, N. E. ¼, Sec. 31, and the S. E. ¼, S. E. ¼ of Sec. 30, and the S. W. ¼, S. W. ¼ Sec. 29, all in T. 40, N. R. 30 W.

The lands are held by Pickands, Mather & Co., Cleveland, O.; C. H. Cady, Agent, Iron Mountain, Mich.

MAP OF CHAPIN MINE, JAN., 1888.

Scale, 390 ft. to one inch.





THE PEWABIC MINING CO.,

is at work near the Chapin. The work so far is embraced in sinking a shaft which is at a depth of 350 feet, with some drifting. At the present time, May, they are cross-cutting at the bottom in a northeasterly direction and are in 100 feet, in mixed ore. The ore is similar to the Chapin ore. Also a cross-cut southwest 75 feet, is in red slate. The company's estate consists of N. ½, S. 32, 40, 30, and joins the Walpole on the east. Some diamond drill boring was done on the property 6 years ago by the Menominee M'g. Co. The present work has been pursued during the past year. The Co. comprise the same gentlemen who control the Chapin. N. P. Hulst, Manager.

THE LUDINGTON MINE,

which is a continuation of the Chapin, west, though it does not seem to be a very large mine after going through the Chapin, still furnishes a good deal of ore.

The Ludington is much better opened than it was a year ago, and if it were not for the limestone and silica appearing in the ore at the east end, I should say that the outlook for the coming year is exceeding good.

There are 3 shafts, No. 1, nearest the Chapin line, goes down through the part of the mine that has caved in. A shaft is in the hanging wall and is a vertical, double cage shaft. No. 5 is at the west end, and is sunk to the 8th level. An addition is the old mine 1,000 feet, west of the west end of No. 5. The mine in the bottom, in the 7th level, at the east end where the ore is the widest, presents one unfavorable feature in the fact of the occurrence of silicious limestone in the ore. The bottom is 5 to 7 sets wide for a length of 200 feet; but on rising up 2 sets high they encounter in the back of ore, in the 3d rise up, this mixture of the rock with the ore.

They have nearly all the back from the 7th up to the 6th level standing and fully opened for stoping. In addition, A shaft is sunk 60 feet below the 8th level—810 feet deep. The cross-cut in the 8th level has been driven 118 feet to the ore.

The west end of the mine does not show any improvement, it is broken up badly and presents considerable irregularity in the 7th level.

They do a good deal of dead work in the Ludington mine. Besides the cross-cut to the ore at A shaft is a rock drift west towards No. 5, 280 feet long, but in the 7th level this rock drift is much less—ore has taken its place.

They are driving in the 6th level west to the old mine, all the way in rock 1,000 feet. The drift is now 300 feet in. As this work costs \$10 per foot,

the whole represents considerable money. They proceed quite rapidly, 55 feet in December.

In the 7th level is another long rock drift going from No. 1 S. E. in direction of ore found with a drill by the Chapin Co. This drift is now 216 feet long. It is easier ground to drive in and costs but \$5.00 per foot.

If I were further to describe the the mine I should repeat figures and statements which I have already made in my last report.

The old mine produced about 8,000 tons all Bessemer ore; the main shaft in the old mine is 200 feet deep. Two grades are made of the ore, Bessemer and non-Bessemer. The former is designated as Ludington and all comes from the old mine and No. 5 shaft; it amounted to 40,068 tons and 1,185 lbs. in 1887. The Star ore, non-Bessemer, was 61,584 tons, 40 lbs. Lean ore 2,636 tons, 1,700 lbs.; total product 104,289 tons, 655 lbs.

The Ludington ore goes 67.7 % iron, .021 % phos.

The Star ore goes 64 to 65 % iron, .095 % phos.

The company sold to the Union Steel Co., Chicago, guaranteeing the ore at the above figures, and came out all right.

The Ludington mine has annually produced as follows:

Year.	Tons.	Year.	Tons.
1880	8,876	1884	101,165
1881	3,365	1885	124,194
1882	52,519	1886	76,983
1883	102,632	1887	104,289
Total			574,023

The mine is in the northeast corner of the S. ½, S. E. ¼, S. 25, T. 40, R. 31. A. D. Moore, General Manager, Iron Mountain, Mich.

THE CORNELL MINE

is now idle. The company is only exploring, driving a cross-cut and boring with a diamond drill. There is not much to say about the mine beyond what has been stated in previous reports. The product for 1887 was 2,068 tons, making the mine's entire production 49,306 tons.

Joseph Fleisham, President, Menominee, Mich.; Capt. Carbis, Superintendent, Iron Mountain, Mich.

THE CANADIAN MINING CO.,

holding a lease of the N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$ and W. $\frac{1}{2}$, N. E. $\frac{1}{4}$, Sec. 26, T. 40, R. 31, near Iron Mountain, has been exploring during the summer. A re-

organization of the company has just been made, January 15, whereby P. J. LaChapelle is made President, D. F. Wadsworth, Secretary, W. J. Officer, Superintendent, all of Ishpeming, Mich.

THE HAMILTON ORE CO.

is still sinking its deep shaft in the corner of its property close to the Chapin and Ludington lines.

I descended to the bottom a few days ago, 920 feet down. A chamber has been made for a pump room on the east side of the shaft; it is 15'x46' in size of floor. The ore extended about 25 feet on the north side and 40 feet on the south side of the room, the east end being in rock in which the men were then working. They mined out of this place 2,000 tons of ore and expected it would prove to be all ore. Originally the shaft was laid out to be parallel and at right angles to the strike of the ore, but it proved to be "angling." They seem to have cut the hanging wall rock going east. The pump will soon be lowered into the place here made ready for it; it is a double acting Worthington, warranted to raise 1,000 000 gallons per 24 hours, 1,000 feet. The shaft will be sunk another level-100 feet-as soon as the pump is in. The dip of the ore is about 80°, and as the shaft is close to the boundary lines and the ore also only appears in this corner, it is plain that the body of it cannot increase in dimensions very rapidly. Further than this there is an apprehension that the formation may turn and dip to the south ere long. When the shaft was begun Mr. Jones expected that the formation would flatten out to the north and that at a much less depth than the shaft has already reached they would be in a large body of ore; naturally there is disappointment.

The company shipped 583 tons of ore the past season.

President, Norman Hall; T. L. Kimberly, Vice President; Secretary and Treasurer, R. Williamson, Sharon, Pa.; John T. Jones, General Manager.

Going west from Iron Mountain on the C. & N. W. railroad, we reach the Commonwealth and the Florence mines, which though not in the State of Michigan, it has been my custom to annually visit and to describe.

THE COMMONWEALTH MINING CO.

has put in a new plant of hoisting machinery, consisting of three drums, ten feet diameter, made at the Marinette Iron Works, with engine 24"x30", and three new Armstrong steel boilers, 62"x16". There is nothing especial to note, that is new, about the mine. They expect with the aid of the new machinery to considerably increase the product in future. The mine is exceedingly irregular. The ore is now making north. Last year the exten-

sion was wholly to the south; the increase in the length of the ore north is 50 feet at the 4th level—that much further north than it was in the 3d. South of the pit there are ore bodies which have been found with the diamond drill, one 75 feet south has a lateral dimension of 191 feet.

The three shafts, B, C and D, are sunk to the depth of 326 feet, 4th level. The west shaft is C, through which a good portion of the product is hoisted. they are opening in the southwest and the west part of the mine. The dimensions of the mine are north and south 250 feet, with an irregular width of working of 200 feet. B is the east shaft, C the west one, and D the north, all to the 4th level and B and D on their way to the 5th.

The mine produced 57,000 tons of ore last year. It averages 60 % in iron and is non-Bessemer; the quality of the ore is said to be improving slightly.

The mine	has produ	ced each ye	ear as follows:
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-
42,94
51,18
57,00

W. E. Dickinson, Superintendent, Commonwealth, Wisconsin.

THE FLORENCE MINE

only needs that its ore should be Bessemer to make it one of the most valuable mines in the Upper Peninsula.

I went through the mine a few days ago and I have seldom seen larger stopes of clear hematite ore. The mine is like the Norway in respect to the stability of the ore and of the rock formation with which it is associated.

In the old mine are some very large chambers that have shown no change since they were formed, and there are some large spaces opened in No. 4. The company unwatered the old mine the past year and mined some ore in it, but it proves to be of inferior grade. There is not market for it.

No. 4, the new mine, 1,200 feet west, is clean ore, and there is a good deal of it; 6% ore, average.

It is 110 feet to 1st level, 160 feet to 2d, and they are sinking to 3d, down 80 feet. It is vertical, double cage shaft.

In the past year No. 5 shaft has been sunk. It is west and north of No. 4, and the ground between and beyond them is all opened in ore, 450 feet in

length, but the limit is not reached; it is still ore beyond. In the 2d level the ore, where it is crossed, is 120 feet wide. They are carrying stopes 42 feet wide and 50 feet high.

The stopes are so large and the roof stands so well that the ore can be broken and put into the cars very cheaply. The Co. employs now, January 15, 100 men, and is mining about 250 tons per day. They have mined and hoisted 510 tons in 10 hours. The mine has four $6\frac{1}{2}$ feet drums, and new Norwalk compressor.

The mine is favorably located, being in the city of Florence, a pleasant, prosperous town.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1880	14,143 100,501 160,155	1886	840 79,399
Total		11	395,270

Henry Tod, President, Youngstown, O.

- J. N. Porter, General Manager, Stambaugh, Mich.
- O. C. Davidson, Superintendent, Florence, Wis.

Edward Ball, Mining Captain.

THE IRON RIVER CO.

has a fine new plant of machinery at the Isabella mine; it consists of three 5 feet Lane drums, engine, Rand compressor, eight power drills, two steel boilers, 5 feet x 16 feet, all in a good, commodious building. The Isabella has turned out remarkably well, having produced 39,493 tons the past year, and is opened to give still more the coming season. It is an open pit 150 feet deep, 77'x65' on the bottom, all ore, besides a drift in south 15 feet is ore. At the north side is a stope of ore 26 feet high, 18 feet long, where a second stope is reached that is 38 feet wide and extends north 85 feet, coming then to a third one that is 21 feet x 18' and goes north 62 feet. The ore is clean, goes 60 % without any sorting. It requires no watching for rock. With the new hoisting machinery the mine is in good shape.

The north mine is also looking excellently well. There has been so little change in the past year that it is scarcely worth mentioning. If the Iron River mine were pushed it could produce a great deal of ore—200,000 tons; but the company seems to produce all it can sell by working the mine

only part of the year. No. 1, the main shaft, is down to the 300 feet level, where the cross-cut to the ore, 80 feet, has been made. In the 200 feet level, south of shaft, have back stoped and filled a length of 150 feet, 50' high and 60 feet wide. There is yet 130 feet in height of ore to the surface sand in this direction. In No. 3 there is a length of stoping ground of 500 feet, with an apparent width of 30' to 40 feet.

There are some new features in No. 2. southeast, the ore has gone 300 feet from the shaft in the 200 feet level. In point of fact the run of ore is all the way from the engine house to the north line, a distance of 1,600 feet. The ore varies in quality, however. In No. 3, north, the ore is lower in iron and higher in phosphorus.

The company has a laboratory and employs a chemist at the mine and the ore is constantly sampled and analyzed.

The annual product of the Iron River mine has been as follows:

Year.	Tons.	Year.	Tons.
1882	29,115	1885	55,693
1883	100,369	1886	78,591
1884	52,584	1887	82,464
Total	***************************************		398,816

Robt. McCurdy, Treasurer, Youngstown, Ohio.

James N. Porter, Superintendent, Stambaugh, Mich.

THE SELDEN MINE

produced 1,302 tons of ore last year, making a total in the two seasons of 092 tons. The pit from which it was obtained is close to the railroad track on the south bank of the river, about a quarter of a mile north of the Isabella pit of the Iron River Co. The company having failed to pay its royalty, its franchises have been cancelled and property is again in the hands of Mr. Selden. As the company had also failed to pay its laborers, the men had seized what little machinery there was by attachment.

THE NANAIMO MINING CO.

I found to be operating its mine, in the N. W. 4, S. W. 4, Sec. 25, 43, 35. There are two pits, situated north and south of each other. The one that has been recently worked is the north one near the river, from the bottom of which they are cutting a drift south to the one on the hill. As the south pit

is in much higher ground, the drift will come quite a depth under it. The mine has not been deepened any in the past year. The ore has all been obtained above the old bottom in the north pit, and the shaft is 180 feet deep on an angle of 63°. The south drift will be 720 feet; it is now 440 feet long. The ore was mainly in three irregular pockets respectively, in size, 25′ x 40′, 15′ x 40′, and 12′ x 40′. They have filled the rooms and mined out the pillars and also filled up the spaces thus made.

They are going to sink 150 feet and rise up and fill, but have first to prepare for taking care of the excess of water. They get 600 or 700 gallons per minute more than their pumps, three No. 9 and one No. 7 Knowles, can well take care of; will add a No. 11 Cameron.

In sinking 150 feet they will make two levels, each 75 feet; work 50 men. I do not regard the present outlook of the mine as very favorable. There is not much ore in sight and they are having a good deal of water, more than the machinery can care for. There is a good deal to be done to get the mine to producing ore—first, they must find the ore and open it up.

The officers are: J. C. Wedge, President; John Spence, Secretary and Treasurer, Fond du Lac, Wis.; Wm. Bond, Mining Captain, Iron River, Mich.

The	product	of	the	mine	for	each	vear	has	been	as follows:
2110	Produce	0.2	OTTO	TITLE TATE O	TOI	OWOLL	,, 0001	11000	OCOLL	COLUMN TO THE PARTY OF THE PART

Year.	Tons.	Year.	Tons.
882	2,250	1886	5,400
883	29,221	1887	30,450
884	38,766		

Analysis of the ore in the bottom level gave iron 61.22, silica 3.72, phos. .363, sulphur .004.

THE BETA MINE

is a small pit east of the Nanaimo, being N. E. 4, S. W. 4, S. 26, T. 43, R. 25. The ore was mined by John McDonald, Iron River. D. C. McKinnon, Secretary and Treasurer, Iron River, Mich.

Product 1886, 1,585; 1887, 1,226; total, 2,811 tons.

THE SHERIDAN EXPLORATION,

adjoining the Beta, is progressing. Mr. Sheridan has a few men at work and has some ore exposed, not enough as yet for a mine of much value.

THE YOUNGSTOWN MINE

has been worked the past year, though it is idle now and the mine full of water.

The work is all at the east end, at the Nelson shaft, where is an abundance of ore. It is too low percentage in iron and too high percentage in Phos. to be very salable. About 55% to 57% in iron and as many hundredths in Phos.

The company shipped 34,041 tons of ore and has 10,000 tons in stock at the mine now.

The shaft, No. 4, is 160 feet deep; it is protected by large ore pillars 40 feet square. The width of the ore is upwards of 200 feet and to what length it may extend is not known, as but little opening has been done. Ventilation is secured by having the opening connect with a small shaft, No. 5, further west.

A new plant of hoisting machinery has been procured, comprising two 5 feet drums; also compressor and power drills. The mine is in shape to produce ore, there is every necessary appliance of the most approved kind.

The owners are the Briar Hill Coal and Iron Co., Youngstown, Ohio.

The officers are: J. N. Porter, General Manager, Stambaugh, Mich.; E. J. Gilbert, Superintendent, Crystal Falls, Mich.; Thomas Ball, Mining Captain, Crystal Falls, Mich.

The mine has yielded as follows:

	Year.	Tons.
6,198	1886	25,638
15,292	1887	34,418
8,343		
		89,887
]	15,292	15,292 1887

THE PAINT RIVER MINE

is not being very strongly worked. It lies east of the Youngstown, and just over the river north of the village of Crystal Falls. The mine holds considerable ore, but like that in the Youngstown it is very high in phosphorus. All the mining work for the past two years has been near the west line of the property, where they have penetrated to a depth of 160 feet. Captain Roberts, who is working the mine by contract, met with the misfortune last summer of having the main shaft, A, cave in. It was sunk through the open pit to a depth of 90 feet. B. shaft is close to the west line. The ore is 70

feet wide, goes 55 to 58% in iron and .50 to .60 in phosphorus. The stoping is mainly in the 90 feet level, going east from B 250 feet. The plan is to let the ground cave in by removing the ore. The shaft is down to 160 feet, but not much done below 90. They aim to mine 25,000 tons of ore in 1888.

Officers are Madison La Monte, President, Chicago; Wm. Eisenbath, Secretary and Treasurer, Chicago; M. R. Hunt, General Manager, De Pere, Wis.; C. T. Roberts, Superintendent.

The annual production has been as follows:

Year.	Tons.	Year.	Tons.	
1882 1883 1884	4,615 5,971 11,546	1885	1	2,374 13,988 10,240
Total				58,679

THE MONITOR IRON M'G CO.

holds lot 6 in S. E. $\frac{1}{4}$, Sec. 20, W. $\frac{1}{2}$, T. 43, R. 32.

The company has a body of ore in which a shaft has been sunk 70 feet deep at 25 feet west of the boundary line, 400 tons were mined last summer that are still at the mine. The shaft is 25 feet in ore, having passed through 40 feet of sand and rock, and they have a drift south 50 feet, all in ore, and one west 25 feet. It is also all ore through east to Paint River mine.

It is apparent that quite a large output could be made if the ore can be sold. It is the continuation of the Paint River deposit.

Officers are W. S. Coffman, President and Treasurer; F. H. Rood, Secretary, Home Insurance Buildings, Chicago, Ill.; C. T. Roberts, Superintendent.

THE FAIRBANKS MINE

was taken on an option the past summer, by Mr. Carl Sheldon and several Milwaukee men, who were to pay \$24,000 for the lease of the mine. They attempted to pump out the shaft adjacent to the Great Western, with the view of sinking it deeper. They did very little, however, and threw up the option.

THE GREAT WESTERN MINE,

the property of the Iron Star Co., I find to be looking about as usual. The mine is systematically worked and yields good ore; but it is not a mine that can be worked economically. There is too much rock drifting for the amount

of ore obtained. The mine is in seven separate pockets or lenses of ore, lying east and west of one another, and they have to be connected by drifts through the intervening rock.

The three shafts are sunk to the 4th level, and on their way down to the 5th. Thy are also sinking a fourth shaft at 370 feet east of No. 3. This shaft is down 34', and as it is still 16 feet further to the ledge through quick-sand, they are having some trouble to get to the rock. It is 50 feet northeast of the engine house.

The length of the mine—the aggregate of the pockets and their connecting drifts east and west-is 720 feet. No. 1 is 134 feet from the west end of the mine, 221 feet to the 4th level, 271 feet to the 5th. No. 2 is 112 feet east of No. 1. Some of the pockets have fine ore bottoms, but not all; in some the ore has cut out. No. 7, the east pocket, is under the engine house; it is a large, flat deposit. At 210 feet east of No. 3, and 100 feet northwest of the engine house, a vertical hole was bored 328 feet deep, in which ore was found at a depth of 237 feet, and the drill continued the rest of the way in ore. They are opening a drift to it in the 4th level, and a branch drift will also be made to the No. 7 room; I went through the mine; Capt. Hooper keeps it in good shape. He is evidently a thorough miner; but there are some serious things to contend with. One is that the mine is so wet. I spoke of this a year ago, and I find it just as bad now. I found some men trying to "make a rise," where a lamp could not be made to burn. They might as well be out in a heavy rain. There are some good stopes, one in the west end that is 70 feet x 12'; also, between No. 1 and No. 2 shafts in the 4th level there is considerable ore, 80' long and of equal width, a fine body of it; another run of ore 115 feet long, and 10 or 15 feet wide. Altogether, I should say, the mine looks neither better nor worse than it did a year ago. I doubt if any profit accrues to the company in working it, and shall not be surprised if the mine is soon closed down.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882 1883	587 22,825	1884	20,722 25,725 23,239
Total	****		93,098

The location is about a mile in direct line from the village of Crystal Falls, in section 21, T. 43, R. 32.

V. K. Moore, Sec., Detroit, Mich.; Wm. Hopper, Supt., Crystal Falls, Mich.

THE JUNIATA

is a name recently given to the Kimball mine, which is situated in the outskirts of the village of Crystal Falls.

The mine is in the S. E. 1, S. E. 1, Sec. 28, 43, 32, and near the south line. The work underground may be described in brief: No. 1 shaft 110 feet deep, No 2, 86 feet; the former the east shaft. They are 245 feet apart and are connected by a drift at the 86 feet level. At No. 1 is a cross-cut north 40 feet, and between the shafts is another cross-cut 84 feet. There are a few other short cross-cuts to explore ground. All the openings are in a good ore formation. Ore—lean ore and mixed ore. There is considerable good ore but it is not yet found of sufficient width. The outlook is favorable for further exploratory work.

The best ore analyzes at 60 % in iron, .070 % phos.

A few men are working—sinking No. 1 shaft—under James Record. The lease is owned by Dr. H. C. Kimball, who, unable to provide the necessary capital, is anxious to sell the mine or to associate others with himself in working it.

THE SHELDON AND SHAFER MINE,

the N. W. 4, S. 31, and S. W. 4, S. 30, T. 43, R. 32, is at present idle. There has been very little done in the past year, the efforts of the owners having been to sell or lease the property.

R. Sheldon and J. F. Shafer, proprietors.

The product of 1887 was 2,377 tons of ore, making a total to date of 43,714 tons.

Still further south in Section 1, T. 43, R. 33, is the Dunn mine, now the property of

THE YORK IRON CO.,

which has been opened in the past year and has developed in a manner to verify the most favorable expectations of its owners.

The deposit extends north and south and is worked in open cut. The ore lies in two lenses, overlapping to the north and separated by rock; the south lense gives a horizontal length of 120 feet, and the north one double that distance. The walls on the east and west go down vertically. The bottom of the mine is clean ore and at one place it has a width of 110 feet. The showing is remarkably good. The "stripping" is pretty heavy; they esti-

mate the amount removed at 14,000 yards. The company shipped in 1887 25,470 tons, and estimate a product of 75,000 tons for 1888.

It is good hematite ore, averages 60% or upwards in iron, and about 25% in Phos. The C. & N. W. Co. has built a branch to the mine and the Co. has conveniences, suitable for the present, to handle the ore. Machinery comprises two 5 feet drums.

F. Schlefinger, President and Treasurer, Milwaukee; H. Schlefinger, Secretary, Crystal Falls; E. Florada, Superintendent; F. C. Bennett, Mining Captain.

THE MASTODON MINE

has a good deal of ore in sight, and Capt. Roberts has things in better shape to get the ore out than he had a year ago. The new shaft north of the open pit is down 200 feet and connected with the open pit mine. So that there will soon be more than one avenue through which to send out ore. Last summer a large ore pillar in the south side of the open pit gave way, precipitating the sand, of which there was a great quantity lying above it, into the bottom of the pit, thus burying the ore beneath a debris that took some time and expense to remove, and delayed the hoisting of ore, as there was but one skip road and that one where the ruin occurred. The pit is about 150 feet deep and at No. 1 skip road the ore is upwards of 200 feet wide. It has been opened a length of 300 feet. It is a lense of ore pitching north 45°.

A boring was made at the downright shaft 300 feet in ore; it makes it pretty certain that the large body of ore, apparent to the eye, will continue in depth. The ore is very hard and firm and stands well in the mine, as is indicated by the immense arch which roofs a portion of the open pit.

The new shaft is 220 feet north of No. 1 skip road, it is 8'x12' in the clear, and worked with a cage.

A new engine house has been built and a new plant of machinery procured, made at the Marinette Iron works. There are two 5 feet drums. The company has also built several new dwellings, which includes a commodious one for the Superintendent, C. T. Roberts. Capt. Roberts works the mine on contract; that is, he mines the ore for 90 cents per ton. The ore averages above 60% in iron and sells well. No fatal accidents occurred the past year; but a look upward at the great roof which spans the pit in the west side of No. 1 must beget with the workmen somewhat of the feeling of uneasiness which is said to prevail among the Assemblymen in the New York Legislature just now regarding the security of the stone ceiling of their chamber. How-

ever it is safe enough—the mine is, not the Assembly chamber—until the breakup in the spring, then they "better look a leedle oud."

Joseph Austrian, Secretary and Treasurer, Chicago.

The mine has produced as follows:

Year.	Tons.	Year.	Tons,
1882	3,477	1885	11,773
1883	18,577	1886	41,640
1884	18,020	1887	49,115
Total			142,566

The estate is the S. $\frac{1}{2}$, N. E. $\frac{1}{4}$, S. 13, T. 42, R. 33 W.

THE MANHATTEN MINE

is close to the Mastodon. It was simply a shaft sunk several years ago to the depth of 90 feet, from the bottom of which a small amount of drifting was done, but no ore was found and the attempt was given up. A short time ago Mr. Ed. Blake, having associated with him a few other men at Negaun ee, undertook to explore the property. Mr. Blake pumped out the water and sunk the shaft three or four feet deeper, when the workmen found a great cavity, vug, in ore. They have gone down 30 feet now, January 10, and a re all the way in clean ore, ore crystallized into form of kidney and grape ore, etc. In quality it corresponds with the Mastodon and is, probably, another lense underlying to the north. At the time I saw it they were only sinking. The description is the N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$, Sec. 24, T. 42 N., R. 33 W.

THE DELPHIC MINE

is in the N. E. 4, S. W. 4, Sec. 24, 42, 33. It has been held under a lease from the Delphic Iron Co. by the Messrs. Whittlesey, of Florence, Wis., but I understand that they have relinquished the lease or that it has expired. At any rate there is nothing doing at the mine. It has been idle for more than a year. The ore shipped was from stock pile on hand, 1,801 tons, making a total to date of 33,246 tons.

THE CALADONIA,

which gave some promise of becoming a mine, has developed nothing of value. The location is in Sections 17 and 20, T. 43, R. 31. Some exploring work was done during the past year under Capt. C. T. Roberts, by Moor, Benjamin & Co.

THE CRYSTAL FALLS EAST RANGE EXPLORATIONS

are very promising. Recent developments have given a good deal of interest to the work in this quarter, especially in township 43, 32. It is in a locality of fine hard wood timber and level land where are few, if any, outcrops, so that there is not much to guide one in exploring.

Last year I described the Blaney, which is now called

THE WAUNETA,

in the N. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 27, 43, 32. Some additional work has been done, and about 1,500 tons of ore taken out. Those interested call it a fair property.

There is one shaft 110 feet deep, with a cross-cut 18' in ore, and a drift with the formation 90 feet long that is in ore.

Mr. H. B. Swain, a reliable explorer and mining man, has charge of the work. He also superintends the work at

THE LEE PECK MINE,

which is in the S. W. ¼, N. E. ¼ of Sec. 26, 43, 32. The mine is in the center of the 40, about 80 rods west of a belt of diorite, that runs north and south, and marks the line of the ore belt through this range. Mr. Swain commenced at the diorite, and made a line of test pits west until he came to the ore.

At the time I went down in the shaft, January 15, it was 78 feet deep. At 56 feet down a drift east, cut 13 feet of ore; one west also found 20 feet of it; but the ore gives way to lean ore again. The formation is mixed ore and rock, and it does not seem that they have yet cut a large body of merchantable ore. What gives interest to the mines in this range is the quality of the ore, which is very nearly Bessemer. None of it is better than is found at the Lee Peck. There is no machinery on the location. Other work has been done, but the above has the main showing of ore.

Mr. S. D. Hollister, of Crystal Falls, has secured options of the W. $\frac{1}{2}$ and the S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$, Sec. 13, S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$ and S. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 14, 43, 32. He has explored for a distance north and south of 2,400 feet along the center of the W. $\frac{1}{2}$ of the W. $\frac{1}{2}$, Sec. 13. This line is about 170 paces east of the west line of the section and extends 200 feet north of the east and west $\frac{1}{4}$ line. In the north pit is hard ore, which analyzes 65% in iron, .013% in phos. South of the $\frac{1}{4}$ line 70 paces is a pit 40 feet deep which is 12 feet in depth in ore; another pit southeast of this is 28 feet in ore, and 50 feet in

depth; 100 paces south of $\frac{1}{4}$ line are three pits, all in ore, and in the south pit of all, 80 rods from the $\frac{1}{4}$ line, I found them raising ore.

Among the analyses of the ore from these pits are the following:

- 1. Iron, 64.10%; phos., .033; silica, 3.58; man., 2.18; sul., .055.
- 2. Iron, 63.65; phos., .039.
- 3. Iron, 59.45; phos., .658; sil., 1.10.

By C. E. Wright, January, 1888.

THE ANGUS SMITH MINE

is as yet the largest find of ore that has been shown up in this east range. It is in the E. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 23, 43, 32, where they have the advantage of being obliged to penetrate but little surface sand—8' or 10 feet only to the ledge. A shaft 60 feet deep is all the way in ore from the sand down, and a cross-cut east and west, 80 feet, is all ore; also a test pit, sunk from the surface 24 feet beyond the end of the cross-cut, came into ore, thus proving a width of ore of 104 feet. It is very nice, clean brown ore. I have seen several analyses of it that gave above 60% iron and within the Bessemer limit in phosphorus.

The company has no machinery, and at the time I was at the location a pit had been commenced in low ground to the south. The pit was down 16 feet, still in soil.

There are other explorations in progress in this locality, among them on the S. E. 4, N. E. 4, Sec. 23, Thomas Mc Cusker has just begun, but his pit showed some ore.

Also in the N. W. 4, S. E. 4, Sec. 23, 43, 32, Paul Du Charme has sunk 42 feet, and was in mixed ore and rock. The exploration is undertaken by Tobin, Parks and Gonyou.

THE JAMES AND RAHRER EXPLORATION

is about $\frac{1}{2}$ a mile east of the Kimball, on the west side of the Paint River, in Lot 6, S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$, Sec. 28, 43, 32.

They have developed a body of mixed ore 50 feet wide and 100 feet long.

THE METROPOLITAN

is the only mine in the Felch Mountain district from which any ore was shipped in 1887. The product was 9,069 tons. It is the property of the Metropolitan Iron and Land Co. Office 151 New Insurance Building, Milwaukee, Wis. H. S. Haselton, Secretary.

I have heretofore described this and the other mines in the vicinity and

the descriptions are published in former reports, particularly in that for the year 1882. There has been little change since the season of 1883.

THE GROVELAND IRON MINING CO.

is a new organization formed to operate a mine in the S. ½, S. W. ¼, Sec. 32, and the N. E. ¼ and S. E. ¼, N. W. ¼ and N. E. ¼, S. W. ¼, Sec. 31, T. 42, R. 29. The lands belong to the Lake Superior Ship Canal and Iron Co., and are held under a lease by the mining corporation. They are described by the company as the East Groveland, Groveland and West Groveland mines.

I have not visited the mine as there is no railroad, as yet, within several miles of it, but I am assured by disinterested men, competent to judge, that it promises to be a good mine. Some of the ore is the fine blue ore, which gave to the Felch Mountain district its early prominence, and which analyzes above 60% in iron and within the Bessemer limits in Phos.

Considerable work has been done; several shafts sunk, one to a length of 75 feet, at which depth it is stated the ore has a proved width of 60 feet. The company has mined 3,000 tons of ore, and altogether the outlook for the mine is a favorable one.

The Superintendent is Capt. Rich'd Lowry.

THE GOGEBIC IRON RANGE.

The great excitement which has prevailed in the Gogebic district since it was opened and became accessible, has utterly died away; the wonderful boom has collapsed, and the succeeding quietness is in remarkable contrast to the activity which till but recently existed.

As a result of this extraordinary boom, while a few men have made money, a far greater number has suffered disappointment and loss, and the final collapse has brought financial ruin to thousands of people. The anticipated fortunes which so many investors eagerly expected to realize, eluded their grasp, and, like the baseless fabric of a vision, vanished into air.

The Gogebic mining craze has had no parallel in the previous history of the Lake Superior region. Something like it may have occurred in an early day, on the opening of mining operations on Keweenaw Point, and in the Ontonagon range; but there were many concomitants in the recent excitement that were wanting in the former period. The Gogebic boom was after the manner of the modern western mining methods, and was accompanied with all the accessories that pertain to the camps, in their earlier stages, in that region.

Gogebic has passed through the experience of a veritable western mining

district, slightly modified by, possibly, less lawlessness, and a better observance of the demands of civilization and decency.

But with all that was baseless and ephemeral, there has been much substantial progress. Nowhere else, in any mining district on Lake Superior, has the development been so rapid as in the Gogebic Range. In the brief space of three years, it is really wonderful how much has been done; in the production of iron ore, in exploratory work, in railroad construction, and in the rapid and substantial growth of the towns. The villages of Bessemer, Ironwood and Hurley are as large and as well provided with the conveniences essential for business and personal comfort as are usually found in towns of equal population only after many more years of existence; fine school buildings, graded streets, plank walks, efficient fire department, water-works, electric lights, elegant private residences, etc., all give evidence that there has been a practical character in the enthusiasm which prevailed. It is marvellous to note with what speed the wilderness has been transformed; but, as sometimes happens, the building has been in excess of the demand.

Residences and business blocks have been constructed in advance of the mineral development. The surpassing mineral wealth of the country was taken for granted; the exorbitant claims of reckless men, who were making every effort to boom the region, regardless of facts, too greatly formed the basis of all the estimates of its mineral wealth. The mistake was made of assuming that the conditions here were wholly different from those which hold elsewhere—that there were two continuous veins of ore extending through the whole length of the range, and thus on each succeeding quarter section of land a valuable mine would occur-and so it transpired that innumerable companies were formed, a company to every quarter or half quarter section for many miles along the range. In all instances, to a greater or less extent, purchasers were found for these stocks, although so far, but a small percentage of these so-called mines has proved to be of any value. Purchasers of stocks or options were disappointed, disgusted, and there is as a result, stagnation, distrust, recriminations, and legal strife, charges of deception, misrepresentation and fraud.

Exploring work is utterly prostrate at this time, June, 1888. Only the mines that have ore, that is ore in quantity sufficient to make it profitable to work, are now active, and these, lying east of the Montreal river, are as follows: The Ashland, Norrie, Aurora, Pabst, Iron King, Colby, Palms, Anvil, Brotherton and Sunday Lake. These are all producing ore, and besides them there are a few others that are worked to a small extent the present summer,

as the Puritan, Ironton, Tontine and several explorations where the search for ore has as yet not been given up.

Aside from the vast amount of disappointment which was felt by the many unsuccessful searchers for ore, the year 1887 proved a discouraging one even for those who were able to produce ore in abundance. The cost of transportation from the mines to Cleveland averaged for the season about \$3 per ton, adding 50 cents per ton for royalty—the price that these mines have to pay—and a mining cost of \$2 per ton, and it follows that there was not a very great profit on ore that sold at \$5.50 to \$6 per ton.

For the season of 1888 the prices for ore transportation from this range are fixed at \$1.95 per ton: 70 cents rail freight to Ashland, and thence vessel freight \$1.25 per ton. Even this is excessive. The ore cars now used hold 20 tons. The mining companies load them, and, being built hopper form, they are made to discharge in a moment, so that for the simple matter of hauling a car of ore over its track from one of the mines to Ashland, a distance of about 40 miles, the railroad companies charge \$14.00. The Ashland mining company paid last year, I was told by the officers of the company at the office, upwards of half a million of dollars for freight. The ore from the mines of this range will probably sell the present season at from \$4.50 to \$5.00 per ton; transportation and royalty will be about \$2.50 per ton, mining cost, inclusive of necessary purchases, machinery, construction, interest on capital invested, will run up to from \$1.50 to \$2.00 per ton, so that the season is not likely to be one excessively remunerative to the mining companies. ore is to remain at its present low price some part of the cost must be cheapened, and in no part can this necessary reduction be made with so much justice as in the transportation. Miners' wages are low enough, \$1.50 per day for company account men-which is now the ruling rate at the Gogebic mines—is as low as they can be and allow the men to live decently.

The important fact regarding the ore of the Gogebic range is that it is practically all Bessemer, ranging from 48% to 65% in iron, and .030% to .050% in phosphorus. Nearly all of the ore which is shipped averages above 60% in iron, and most of it below .042% in phos. So that it is good ore.

Since Bessemer pig metal enters more and more into construction of all iron materials it follows that the demand is for little other than for Bessemer ores, and, so long as these ores can be obtained in sufficient quantity and at a moderate price, there is no other process of steel making likely to supersede the Bessemer.

An important feature of the Gogebic iron range, affecting adversely the continuity of ore deposits, is the occurrence of dykes of eruptive rock that are found in most of the mines and show a tendency to cut out the ore. The

miners designate them as soap rock. The material is generally soft and friable, but is sometimes hard, approaching diorite, which it originally, probably, was.

They cut through the formation, dipping southeast, making an acute angle with the horizon, usually about 30°. I have observed but one instance where the dip was, apparently, to the southwest. Where one of these dykes is found under the ore, if it is of much thickness, it cuts out the ore completely. It seems to constitute a boundary of the particular lense of ore with which it is found to be in contact.

The Gogebic range is too new for me to say too much regarding the continuance of the ore. The surface has been a good deal explored by test pits and these show everywhere along the range very similar results, a ferruginous schist, jaspery schist, ore mixed with rock. Sometimes small seams and pockets of clean ore, which lead to the hope that deposits of greater magnitude will soon be found, and so the work is continued, but, probably, no better result is obtained.

A little ore may be found but not in quantity great enough to be of any practical value.

Perhaps it is necessary to sink to a greater depth; there are properties on which much exploring work has been done and where I should certainly recommend that they penetrate deeper.

I have recently spent a few weeks on the Gogebic range, going through the mines, and will extract from my notes briefly such statements regarding them as it seems to me it may be desirable to mention.

In doing this I shall, as heretofore, commence with

THE ASHLAND,

which is the most westerly of the Gogebic range mines in this state, being just east of the Montreal river, the boundary, at this point between Michigan and Wisconsin.

A year ago the Ashland was regarded as perhaps the first mine on the range in point of value. It had just been purchased by gentlemen connected with the Wisconsin Central R. R. at, as reported, \$40 per share, \$1,600,000. In examining the mine I saw but one thing that could awaken apprehension regarding the continuance of the ore, and that was the "soap rock," the eruptive rock cutting the formation. The subsequent development has disclosed this rock in all the shafts in the mine, probably occurring in a succession of dykes. The company holds a quarter section of land and thus has a half mile in length of the ore formation. The shafts are located on or near the quartzite foot wall, so frequently referred to, and commencing at the

west, No. 1 shaft, the distance thence to No. 2 is 290 feet; thence to No 3, 220 feet; thence to No 4, 250 feet; No. 4 to No. 5, 350 feet; No. 5 to No. 6, 420 feet; No. 6 to No. 7, 300 feet; thence to No. 8, 380 feet, and from No. 8 to east line 60 feet.

The shafts are in depth respectively as follows: No. 1, 80 feet; No. 2, 100 feet; No. 3, 340 feet; No. 4, 340 feet; No. 5, 100 feet; No. 6, 200 feet; No. 7, 145 feet; No. 8, 175 feet.

In No. 1 are two levels. The ore in the 1st, extends west of the shaft 180 feet, and to the east 100 feet.

In the 2d level the ore extends 40 feet west and 100 feet east; below the 2d level is a triangular prism of ore between the "soap rock" and the foot wall.

Just at present all the ore taken from the mine comes from Nos. 3 and 4 shafts, with a little from No. 8. In the former pit the ore is pretty well exhausted above the 3d level, but between the 3d and 4th levels, a depth of 80 feet, it is nearly all standing opened ready for stoping. Below the 4th level the ore will be east of No. 4 shaft, reaching a length of 280 feet; assuming that the underlying rock and the rock capping continue at their present angles. Both shafts are sunk to the "soap rock" and through it No. 3 goes down vertically 150 feet, when it intersects the foot wall, which it is then made to follow, occasioning two angles in the line of the shaft. No. 4 shaft cuts the dyke at 300 feet from the surface, and is sunk 45 feet further; below the 4th level at No. 4 there is 25 feet of ore to the rock; the dyke has a thickness of 30 feet, and below it is the same rock that is found above the ore "capping." At No. 3 shaft the dyke seems to split, the main body continuing at the same angle, while a portion goes off much flatter to the east. Under this latter, between it and the main body of "soap rock," ore is found, but of a harder texture and higher in phosphorus. The ore body in the 3d level at No. 4 shaft has an average width of 100 feet and a length of 540 feet. At the 4th level the average width is 60 feet and the length 440 feet. No. 4, which is vertical, intersects the foot wall at a depth of 310 feet. The ore is reached from the shaft by cross-cuts to the north through mixed ore and rock. In the 3d level the cross-cut is 75 feet, and in the 4th it is 25 feet.

The hope is entertained that the ore in No. 4 in its pitch to east will make under the dyke at 6 and 7 shafts. It is certainly a lense of ore underlying the ore at the east end, and also is north of it, and may be found, at greater depth, below No. 6 and 7 shafts, or rather be found north of and under the dyke that cuts out the ore at these shafts.

Nos. 6 and 7 shafts have both been sunk below the dyke but no ore was found.

I	was shown two	analyse	es of ore, recen	tly made	which gave	
	Iron	67 S	Silica	1.87% I	Phos.	.050%
	Iron	65 S	Silica	3.00% 1	Phos.	.042%

The following table is of interest. Analyses made by Mr. Olcott, the company's chemist and engineer.

Comparative Statement of Ashland Mine Ore for the season 1887.

Month.	No. 1 Shaft. No. 3 Sha		Shaft.	naft. No. 4 Shaft.		Nos. 6 and 7 Shafts.		Monthly Averages.		Cargoes.		
	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.
June	62.41	.061	60.22	.052	60.36	.043	62.75	.036	61.45	.048	62.66	.053
July	62.71	.064	58.19	.054	58.86	.042	62,66	.039	60,60	.050	61.97	.048
August	62.56	.061	61 81	.053	58.11	.044	62.58	.036	61.26	.0485	61.75	.047
September	62 69	.059	64.51	.058	61.78	.043	63.08	.038	63.01	.0495	62.90	.048
October	63.70	.074	65.07	.052			62.82	.050	63.94	.0586	62,29	.053
Av. for season	62.82	.064	61.96	.054	59.78	.043	62.82	.040	61.88	.050	62.29	.050

Up to June 1 the following table shows quality of the ore shipped:

Average of Analysis of Ore shipped in 1885.

Number of Shaft.	No. tons of ore shipped.	Percentage of Iron.	Percentage of Phos.
Three	20,073	65.77	.046
Four	11,677	65.02	.045
Six	948	64.91	.029
Seven	19,464	62.54	.057
Season	52,162	64,38	.0498

The timbering in the mine costs $28\frac{1}{3}$ cents per ton of ore. At the present time the force employed is 350 men.

The officers are Chas. C. Colby, President, and W. H. Abbott, Secretary, both of Milwaukee; E. A. Hayes, General Manager, Ironwood, Mich.; John A. Taylor, Superintendent; W. J. Olcott, Mining Engineer and Chemist. The mine is at Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885 1886	6,±71 74,015	1887	175,561
Total			256,047

THE NORRIE MINE,

which joins the Ashland on the east, is now, apparently, the best mine in the Gogebic Range. It is producing the most ore, and seems to have the most of it. Certainly there is more ore in sight available for mining than is found in any other mine in this range. The Norrie has improved since one year ago. Formerly, the length of the mine underground was 850 feet; it is now 1,600 feet, with no diminution in width.

One can enter the mine at the west line, where it is opened through into the Ashland No. 8 shaft, and traverse in the third level through a continuous run of ore to No. 6 shaft, 1,600 feet distant. The ore is, of course, of varying width, attaining a maximum of 270 feet. The 4th level, to which the shafts are sunk, is not much opened yet, the ore being derived from above the bottom of the 3d.

Already there has been shipped in 1888, 100,000 tons of ore, and the output will reach before the end of the season, 250,000 tons; perhaps 300,000. There is some non-Bessemer ore obtained at No. 6 shaft, otherwise the product is all of the best quality of Gogebic Range Bessemer ore, about 63% iron average. Fortunately, there is, as yet, no occurrence of soap rock dykes in the mine, but there is a peculiarity of the foot wall which is not found elsewhere, at least to so exaggerated an extent, though this does not in the least affect, adversely, the quantity of ore. The foot wall flattens out and extends a great distance north, carrying the ore body with it, thus necessitating long cross-cuts from the shafts to the ore, the shafts being started on the foot and continued down at the same angle. Nos. 3, 4, 5 and 6 shafts are to the 4th level, 330 feet deep. No. 1 is in the low ground near the Ashland line, and opens a fine body of excellent ore. The method of mining, which I have heretofore described, consists of the now common plan, of cutting out the ore in sections across the formation, making what are termed rooms, which are separated by pillars of ore. The open spaces are timbered after the Nevada system. A period has been reached when a change must be made; "caves" are liable to occur, and must occur before long. The rooms must be filled either by letting in the surface, or with material derived elsewhere; no doubt the plan adopted will be to let down the overlying dirt and rock, and then mine out the pillars and fill the spaces thus made also. The timbers used at the Norrie and at other mines in the vicinity, are all framed by machinery to an exact pattern. The tenons on the posts are round, and the caps, when set on the posts, make a perfect fit, and secure the greatest strength and stability. But no timbering, however well done, will, in the long run, hold up a mine so extensive as the Norrie.

The officers remain as heretofore: S. S. Currie, Pres't Metropolitan Iron and Land Co.; H. S. Haselton, Sec.; R. H. Hanna, Treas., Milwaukee; Jeff. D. Day, Sup't; Wm. Treblecock, Mining Capt., Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885 1886	15,420 124,835	1887	217,384
Total			357,639

In the above is included the product of the East Norrie, which produced in 1887, 15,896 tons.

THE EAST NORRIE

joins its namesake on the east and is greatly improved of late. No. 1 shaft near the Norrie line has opened into a fine body of ore, 200 feet long and 80 feet wide, though as to the full width, that is not determined yet, as the hanging wall had not been reached at the time I last saw the mine, June, 1888. The shaft is 170 feet deep on the foot wall, and there are two levels; the 2d level is proving far better than the 1st did. The ore body is wider.

The mine is under the same management as the Norrie.

THE AURORA MINE

is also looking well, though the west part of the mine, the Aurora mine proper, is exhausted. The ore is about all worked out, and the mine is now mainly in what was a year or two ago new ground, all to the east, in what is known as the Vaughn property.

The mine has continuous opening for a length of 2,000 feet. The most westerly shaft is 90 feet deep, and thence to "old No. 1," it is 360 feet. No. 1 is 140 feet deep, is in the open pit, and thence to No. 2, it is 172 feet to where the underground mine begins. No. 2 is to the 3d level; from this to an air shaft 60 feet deep, is 155 feet; and thence to No. 3 shaft is 343 feet;

the latter to the 4th level, 235 feet deep. From No. 3 to No. 4 shaft is 286 feet: the latter is 300 feet deep, sunk to the 5th level, and is used for pump and timber shaft. They sink No. 4 and drift each way to the others, and rise up for connection with the levels. To No. 5 is 146 feet east from No. 4, and the shaft is 229 feet deep, to the 4th level. Thence to an air shaft, which is 52 feet deep, the distance is 177 feet; and from this to No. 6 it is 266 feet.

Descending No. 6 shaft to the 4th level, we begin at the east end of the mine and may walk westerly, through a continuous opening in ore 20 feet to 100 feet wide, for a length of 1,200 feet. From No. 6 west for 800 feet, the ore is from 3 to 5 "sets wide;" that is, from 21 feet to 35 feet, averaging about 30 feet. At No. 6, the width of the ore is not determined; the ground is new; they have cross-cutted north from the wall 35 feet, and are still in ore; it may attain a great a width here as at No. 3, where, for a length of 300 feet, the ore is 12 to 13 "sets" wide; in fact, they were putting in the 13th "set" and were not to the hanging wall; each "set" is 7 feet square. In this part of the mine pillars of ore are left to aid the timbering in supporting the mine; but elsewhere the ore is all taken out, and the timbers alone suffice. The timber work is well done, and there is no evidence, anywhere, of an undue pressure. The ore is very firm and dry, and stands well in the "back." The miners can advance a whole "set," or even the space of 2 or 3 "sets" before putting in the timbers, without danger. All the water in the mine is pumped up through No. 4 shaft by one Knowles

The foot wall is generally very regular. The mine can not extend much further west since it will reach the Pabst line. The "soap rock" which cut out the ore west is found at the bottom of No. 2 shaft. It held a regular dip and pitch to the southeast in the great open pit where it formed the bottom of the ore and will, probably, be ultimately found in the same manner under the ore going east.

The mine is not open below the 4th level, and above this bottom they have raised "4 sets" 28 feet, leaving about 6 sets to be mined before reaching the bottom of the 3d level. It is expected to mine 150,000 tons in the season of 1888. If the 5th level were opened, and the work were pushed vigorously, a much greater product could have been secured. The Aurora, properly, is the E. $\frac{1}{2}$, S. W. $\frac{1}{4}$, and the Vaughn consists of the N. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 23, 47, 47, making $\frac{3}{4}$ of a mile of length of the iron range held by the company.

The title of the corporation is the Aurora Iron Mining Co.

The officers are Stevenson Burke, President; Andrew S. Upson, Vice President; Franklin T. Ives, Treasurer; Charles F. Rand, Secretary. Office,

101 St. Clair street, Cleveland, O. Nat'l Hibbert, Superintendent, Ironwood, Mich.

The following summary of analyses will convey a clear idea of the quality of the ore:

Eleven analyses of average samples from No. 2 shaft give an average, iron, 62.30%; silica, 6.50%; phos., .033%.

Same number from No. 3 give, iron, 62.60%; silica, 4.22%; phos., 032%. Twelve samples from No. 5 shaft give, iron, 62.75%; silica, 3.88%; phos., .0327%.

It will thus be seen that the ore is of extra quality. Some analyses go below 60% in iron and a few above .040 in Phos., but the ore seems to be all clearly Bessemer.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1886	101,037	1887	154,095
Total			255,132

THE PABST MINE,

joining the Aurora on the east and north, is looking much better than it did when I previously saw it. 'The company has sunk a shaft 360 feet north of the quartite foot wall, 200 feet deep, and has opened a large body of ore. It is the best showing, by all odds, that the Pabst Co. has found on the property. This shaft is a good piece of work, mechanically, and was rapidly done. It is 6' x 14' inside the timbers, inclines to the north at an angle of 66°, is in the rock 40 feet south of the ore and is provided with two skips. The bottom level is much the best. The body of ore is larger and the ore is cleaner. They are working 180 feet east and 150 feet west of the shaft, ore continuing in both ends; east of the cross-cut from the shaft they are rooming out and were putting in the 9th "set," will probably be about 12 "sets" wide-84 feet. West of the cross-cut are five "sets" wide, so that it shows from 30 to 80 feet wide for a length of 340 feet, with probably an increase of these dimensions. Now this would be very nice for the Pabst folks if the ore were clean; unfortunately it is not, it contains too much sand, disseminated in spots and seams, etc., throughout the ore body. Of course it is worse in some portions than in others, but it is difficult to separate anywhere from the ore and reduces the iron percentage to about 58% to 60%, Phos., .035 to .042%.

Capt. Stevens has an ingenious and effective contrivance for stopping the skips in this shaft which I have never seen elsewhere. This ore was found by sinking an exploring shaft 170 feet deep, now used as an air shaft for ventilation. This new pit is called the Baetz shaft.

The positions of the shafts are described in my last report. No. 1 is the east shaft, 45 feet west and 360 feet north from the corner of the property. The plan is to work this and Nos. 2 and 4 shafts, the latter being the west shaft and No. 2 being about midway between them. No. 4 shows well, the shaft is 200 feet vertically down, where it intersects the foot wall, thence 45 feet following this foot. Drifting west from the shaft only rock is found so far as gone, but east there is ore all the way to No. 2, 450 feet. At 175 feet west of No 2 the ore widens out to 35 feet. They are opening towards No. 4 and have the ore this width for 50 feet. It will continue 30' to 35 feet wide for, perhaps, a length of 100 feet. There is a drift all the way, along the foot wall, in ore from one shaft to the other, and altogether this bottom level shows much more ore, and cleaner ore, than was found in the level above.

No. 2 has been sunk to this bottom level, 245 feet. The ore went south into the foot wall so that the shaft, which starts at the surface on the foot with an angle of descent of 60° is now 80°, and still there are several feet of ore behind it, between it and the wall.

Altogether the Pabst has improved in the past year considerably.

The officers remain as heretofore, Fred Pabst, President; Chas. Best, Jr., Vice President and Treasurer; Henry Baetz, Secretary and General Agent; W. W. Stephens, Superintendent.

Offices, 917 Chestnut St., Milwaukee, Wis.

Mine office, Ironwood, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1885	1,153 17,925	1887	19,906
Total			38,984

Adjoining the Pabst is

THE IRON KING,

one of the most valuable mines in the Gogebic range. It has been involved with the others of the so-called Burton group of mines to which it belonged,

in the long controversy that grew out of Mr. Burton's financial embarrassments. It is now held by the Bessemer Consolidated Mining Co., which has become the owner of the Burton mining properties, consisting of the Iron King, Bonnie, First National, Blue Jacket and Valley.

Dan'l Mc Garry, President, Cleveland, Ohio; Mason W. Burt, General Manager, 164 Bank Street.

The Iron King is the only producing mine in the lot, and as all the others are, and have been, only sources of expense, the resources of the Iron King are taxed to meet the outgoes on these non-paying properties. Lack of funds and uncertainty as to final ownership kept the mine practically idle during the winter, and even now the work is not strongly pushed. They are only working two shafts, Nos. 1 and 2, which are in the north deposit and are 209 feet apart. They are 340 feet deep, being to the 3d level, which is just opening up. The body of ore gives a working length of 1,000 feet and a width of from 40 to 100 feet. The main thing to be apprehended is the "soap rock," which may be found strong enough to cut out the ore. I noted it at several points in the mine, and it seems to dip southwesterly, instead of easterly, as is the case elsewhere. Thus it will tend to shorten the ore body on the east, leaving it to lengthen west. The ore is of the very best found in the range, averaging 62% in iron and about \$030% to .035% in phosphorus.

The shafts are numbered from the west to the east, 1, 2, 3, 4 and 5. In my last report is a full description of these shafts and of the mine generally, and there has been so little change since then in much of the mine, that I note little to add to what I have previously stated.

In the south vein, or on the quartzite foot wall, there is a good body of ore 135 feet long and 60 feet wide. The shaft is 210 feet deep. The ore, I am told, is of poorer quality than the north vein ore. Certainly it is, much of it, highly manganiferous. They are not mining this ore.

The company is raising this summer 500 tons of ore per day. About 150 men are employed, mostly miners.

The mine is timbered after the usual manner, 21 foot pillars are left, and the headings are of the same width—3 sets. The machinery, etc., has received no change.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.	
1886	27,343	1887	74,609	
Total			101,952	

The description is the N. W. 4, Sec. 24, 47, 47. E. H. Jones, Sup't, Ironwood, Mich.

THE BONNIE IRON MINING COMPANY'S

property joins the Iron King on the east. I described the mine in considerable detail in my last report from notes taken a year ago, and there has been little in addition developed since then, except that ore was found in the north vein.

A shaft, which had been previously sunk 75 feet, was carried down to a depth of 135 feet, and a body of ore found which Capt Jones tells me is 35 feet wide. The Bonnie is a property which affords indications of possessing ore in sufficient quantity to be workable.

It is held by the Bessemer Consolidated. M. W. Burt, Gen'l Manager; Daniel McGarry, Pres't, 164 Bank St., Cleveland, Ohio.

Product, 1887, 1,003 tons.

THE FIRST NATIONAL IRON MINING CO.

has also passed to the control of the Bessemer Consolidated Mining Co. Daniel McGarry, President, Cleveland, Ohio.

The mine is idle and there has been no work done for a year past. The description given in my last report, 1886, written in 1887, suffices now as well as then.

Ore shipped in 1887, 1,997 tons.

And precisely the same may be said of the

BLUE JACKET MINE,

which lies east of the former, and remains now precisely as it was when I saw it and described it one year ago. Work was soon after discontinued and none has since been done. The estate consists of a \(\frac{1}{4}\) section of land—the S. E. \(\frac{1}{4}\), Sec. 18, 47, 46, and four shafts have been sunk to the maximum depth of 160 feet. It is one of the Burton group of mines that has passed to the control of the Bessemer Consolidated Mining Co. Daniel McGarry, President, 101 St. Clair street, Cleveland, O.

Product for 1887, 2,070 tons. Joining the Blue Jacket is

THE RUBY IRON MINING CO.,

which is the new title of the Puritan, the mine having passed to other owners.

President, M. A. Hanna; S. W. Folsom, Trustee; C. S. Russell, Agent;

W. P. Bice, Superintendent, Bessemer, Mich.; S. Hitchcock, Secretary, 101 St. Clair street, Cleveland, O.

The description of the land is the S. W. 4, Sec. 17, 47, 46. The Ruby was one of the most promising mines of the range. There was a fine showing of ore and the indications were very favorable for the development of ore in much greater quantity. The surface has been pretty thoroughly test pitted and the pits all show very similar results-rich jasper, or jasper and ore. One cannot but think all the while that somewhere clean ore will be found. I can see no better way to determine whether there is any value in the property but to sink deep, near the foot wall; go down, if possible, through the capping. There may be lenses of ore lying deeper. The fine body of ore at the east end, which was divided between the Ruby and the Ironton, has been entirely exhausted, as have also all the other deposits that were working a year ago. I described the mine with unusual fullness in my last report, having given considerable attention to examining it. The only work doing at the mine now is mining a surface pocket of ore and sinking No. 4 shaft, which has been carried down 80 feet and is still sinking. The shaft is now 200 feet deep and is in rock, as is also a cross-cut north at the bottom, in 30

The company works 25 men in its exploring work. The Ruby has received a pretty large expenditure of money in the aggregate.

The following is the product:

Year.	Tons.	Year.	Tons.
1886	16,388	1887	42,065
Total		· · · · · · · · · · · · · · · · · · ·	58,453

THE BELMONT

is an exploring shaft just north of the north line of the Ruby which Capt. Mat Fitzsimons of Ironwood, Mich., has been engaged in sinking for more than a year, and which work he is still prosecuting.

Capt. Fitzsimons is also still prosecuting the exploring work at

THE NORTH AURORA SHAFT

and expresses much confidence in the final outcome. He states that the shaft is 300 feet deep, vertical, and that he is cross-cutting north in the bottom where, at about 25 feet in, he has cut a deposit of slate ore which had also previously been intercepted further up in the shaft. The shaft is very

wet. I did not go down into it. Its location is in the southeast corner of the property, being near the Aurora and the Pabst lines, the latter being the adjoining property west. If a valuable discovery of ore is made, it will, probably, prove to be equally as important to the Pabst company as to the North Aurora.

There are other explorations in progress, north of the Iron King and Pabst, as

THE NEWBERRY,

but no ore in quantity has been found yet.

THE IRONTON IRON MINING CO.

has also the misfortune to have exhausted its ore. All the ore the mine has produced has been obtained from the deposit at the west end, the one crossed by the boundary line, and that is completely worked out. The shafts that were sunk west towards the Tontine did not lead to the discovery of any ore.

At 50 feet below the bottom of the west pit, a drift east cuts a vein of ore, which, beginning at 5 feet in width, expanded to 12'. It is good ore, analysis showing it to be above 60% in iron, and .030% Phos.

Two drill borings have lately been made from the bottom of No. 1 shaft, near the west end of the mine, one to the north 100 feet long, through hard ground, but no ore. The second hole was bored down at an angle of 60°, 106 feet long, and ended in ore. They will sink the shaft 100 feet; it is now 141 feet.

They feel quite confident of finding a body of ore.

The machinery and all the other shafts, etc., remain as they were at the date of my last report.

The mine produced the following:

Year.	Tons.	Year.	Tons.		
1886	16,307	1887	27,887		
Total					

President, Dan'l McGarry, 164 Bank St., Cleveland, Ohio; M. W. Burt, V. P.; Geo. H. Abeel, Sup't, Bessemer, Mich.

THE FEDERAL LAND AND IRON CO.

is the new title given to the Tontine, the company whose mine lies next east from the Ironton. The property was sold out last winter and was bought at

a nominal price by the present owners. The shaft was 145 feet deep; they started a drift east, and at 60 feet cross-cutted north 80 feet, and claim to have gone through in this cross-cut, 41 feet of good ore. They have, along the foot, 6 feet of mixed stuff, and then come into clean ore. I did not go into the drift. They have the ore in stock pile; it looks a little ocherous; is, they state, well up in iron, and also is high in Phos. At 30 feet from the shaft east, another cross-cut was driven north 25 feet and a rise made in ore, but they found too much water to proceed. They have also sunk the shaft to a depth of 175 feet, and it is nearly all in ore.

They are having a good deal of water, and only one boiler and one No. 7 Knowles pump to keep it out; an accident to either, and the mine would soon be flooded.

The force employed is 18 men. Gage E. Tarbell, Sec. and Gen'l Manager, Milwaukee; D. A. Bennett, Sup't, Bessemer; Wm. Knowles, Mining Capt., Bessemer.

Adjoining the Federal, between it and the Colby, is

THE VALLEY MINE,

the property of the Valley Iron Mining Co., or rather, perhaps, of the Bessemer Consolidated Mining Co., since the Valley is one of the Burton group of mines that went to the possession of the Bessemer Consolidated.

So far, however, the Valley has not proved to be of any value. Considerable money has been expended in mining and exploring work, and a large sum paid for the control to start with, all of which, it would seem, is a dead loss to the owners. It is entirely idle, and it is not likely that more work will be done very soon.

The mine furnished for shipment, in 1887, 322 tons. Dan'l McGarry, Pres't, 164 Bank St., Cleveland.

THE COLBY MINE,

the great bonanza of the Gogebic Range, the Jumbo of iron mines, gives every present indication of having reached the limit of its capacity of production, in fact it is apparent that unless other discoveries of ore are made, the mine must be ere long exhausted.

The Colby mine was an immense deposit of clean ore lying against a quartzite foot wall on the south and an eruptive dyke on the north. This dyke cuts the formation at about right angles, but also inclining east at about 30°. This dyke has formed the bottom of the mine in all the levels, that is, it has crowded the mine further east constantly, as greater depth is attained.

At first the mine was divided into two deposits by reason of an upward bulge in the undercutting dyke and a corresponding downward sag in the rock capping, which overlies the ore; but in the process of mining the north deposit has constantly approached the south, being carried there by the dip of the dyke in that direction.

This separation of the ore into two deposits gave rise to the theory of two distinct veins of ore traversing the whole length of the range. A cross section of the mine shows the ore in a triangular trough, the sides of which are the quartzite and the "soap rock."

At first the south deposit had great width, but naturally it is narrowing and also shortening, since the rock underlying at the west end goes down at an angle of 30°, and the capping at the east end, which limits the ore in that direction, dips down at about 45°. The two deposits are connected in the third level. There are four levels opened, and the east shafts sunk to the 5th level. No. 1 shaft was the outlet at the west end of the open pit, and No. 2 is a skip road that ascends the foot wall at the east end of the open cut, and Nos. 3 and 4 shafts are further east; both go down under ground. No. 2 is 130 feet long, and the others, respectively, 250 feet and 300 feet. No. 3 is 300 feet east of No. 2, and No. 4, 300 feet east of No. 3. The length of the ore body is 650 feet in the 3d level, and the width in the 4th level averages, perhaps, 35 feet, but No. 3 shaft at the 4th level is to the rock. The ore reaches about 25 feet west of the shaft and extends 180 feet east of No. 4, making a length of 500 feet.

In the 5th and 6th levels the ore will be taken from No. 4 shaft, as that will be the only one in the ore.

They are scramming some ore in the open pit; otherwise, with the exception of No. 2, all the ore comes from three shafts; the two above mentioned, and a third one in the north pit. No. 4 is to the 5th level and opening out. It will probably reach the "soap rock" at the 6th. The capping will come down at the end terminating the ore deposit. A few borings have been made through the "soap rock" but only mixed ore and rock found under it. However the borings were made vertical. It would have been better, I think, to have bored at right angles with the dyke and so have kept away from the foot wall. Possibly it might be well to go over on the side hill west of the mine and drive in a tunnel under the "soap rock." It would be a better test than boring. Of course there is yet a great deal of ore in sight.

The company expects to ship this season 300,000 tons. There are 100,-000 tons in stock at the mine, and at the time of my visit they had begun to load the cars from the stock pile with a steam shovel; it was doing the

work satisfactorily. They estimated the cost at 4 cents per ton, were loading a car of 20 tons in 7 minutes.

The north deposit has afforded very cheap ore, undoubtedly. It has been so simple a matter to drop the overlying rock down on the dyke. They claim to have got 90% of the ore. The plan pursued has been to take out all the ore, as nearly as possible, and let the top come down.

The lease on which the mine has been worked, so far, expires in November next. Mr. Jos. Sellwood leaves soon for the Vermillion range and the mine then will be more exclusively in charge of Capt. Harry Roberts.

The shaft on Section 15 east of the main mine is not turning out so large as was anticipated when the mine was first opened. The deposit has a length of 120 feet and a width of 40 feet. They mine it on the "soap rock," the same manner as in the north deposit.

West of No. 4 shaft the ore is narrow, 15 to 20 feet wide, and between the shafts averaging about 30 to 40 feet.

An explosion of giant powder occurred at the mine in May, 1888, destroying the engine house and the lives of two men. It is not known how it occurred. The powder was in the engine house to be kept warm and by some unknown cause was made to explode.

The mine has produced as follows:

Year.	Tons. Year.		Tons.
1885	84,312 257,433	1887	258,518
Total			600,263

Jos. Sellwood, Manager, Bessemer, Mich; Pickands, Mather & Co., leasees, Cleveland, Ohio.

THE PALMS MINE

is the next one east of the Colby, being the N. W. 1 of Sec. 14, 47, 46.

I described the mine, machinery, etc., very fully in my last report, and there is not much to add. It is one of the best equipped mines, in the matter of machinery and shafts, on the range.

The mine is really looking better than it was a year ago; they have a better deposit of ore than I have ever before seen in the mine. When Capt. Christopher took charge of the mine he found it completely exhausted; there was no ore, of any value, anywhere; he wisely decided to sink No. 3 shaft, and has lowered it 87 feet. He opened a level at 50 feet, and drove east 120 feet, all the way in ore, part of it 3 sets wide, 21 feet; but found no ore west. At

37 feet further down, the ore deposit appears still better than it did above; since they find a good showing of ore west of the shaft 7 or 8 feet wide. The shaft is 270 feet deep. The company has done a good deal of drifting, cross-cutting, etc., that, in the nature of things, could be of little value; it was done too near the surface. In the first level, 78 feet below the surface, is a drift 500 feet long, connecting three shafts. The drift is all the way in "cap rock." If made at much greater depth it might have cut some ore. Also there are many cross-cuts, one that is 100 feet long, at the 180 foot level.

From No. 3 shaft, and out of a chimney of ore near No. 2 shaft, they are raising now about 150 tons per day. The indications favor the plan of sinking deeper, following the foot wall.

Also I should think it would be a good plan to explore the west part of the property. About the mine, and east to the Anvil and north, the ground has been pretty well test pitted without finding any deposit of clean ore. The ground west has not been tested much. There was shipped from the mine, in 1887, 1,600 tons of ore. Corporate title is the Palms Iron Mining Co. Wm. Irvine, Treasurer, Chippewa Falls, Wis.; J. P. Christopher, Sup't, Bessemer, Mich.

The ore averages above 60% in iron; is Bessemer, but is about at the limit, being comparatively high phosphorous.

The Palms has admirable arrangements for handling ore economically; both railroad tracks extend along on the foot wall side, and the pockets, which receive the ore from the skips, discharge directly into the cars.

The surface is high, unbroken ground.

THE ANVIL MINING CO.

has made considerable change for the better at its location adjoining the Palms. The railroad companies, the Wisconsin Central and the Milwaukee Lake Shore and Western, have built tracks along on the foot wall side of the mine, to accomplish which a long high trestle across the ravine next to the Palms mine has been made.

A new engine house has been built and a suitable plant of machinery secured.

The mining is all confined to No. 1 shaft near the west side of the property. They are stoping there in the deposit of ore that is described in my last report, and which had then been recently discovered.

Capt. J. H. Johns has the contract of mining out the ore above the 1st level, taking it all to the surface dirt. His method is by making innumerable

"rises" through the ore; starting with a main rise, which is provided with a shute to receive the ore and to discharge it into the tram cars. Connected with the main rise are numberless branches so made as to leave finally nothing but arches of ore. When a block of ground has been sufficiently perforated in this way, the arches are blasted, and the whole made to come down, when as much of the ore is saved from the dirt as possible. The ore is dry and firm and has no tendency to crumble and fall away, and as the deposit is not a very large one, the method of mining is cheap and effective. The bottom of this level is 175 feet below the collar of the shaft, and another level has been opened 50 feet below, in which the ore body seems to hold its bigness and the ore to improve in quality. This main ore body is apparently about circular in horizontal section, that is, about as great in diameter in one direction as in another. I do not know the dimensions. Capt. Johns could not inform me, but I judge it to be from 80 feet to 100 feet east and west, possibly a little larger north and south, with the axis inclining down to the northeast. It is separated from the foot wall ore by a belt of rock about 25 feet thick; the latter deposit of ore along the foot wall has a width of about 10 feet, and has been opened east under No. 2 shaft, which will be connected soon, and will also be used for hoisting. They are mining and shipping now, June, 1888, about 150 tons per day, working 35 men. Capt. Johns receives 60 cents per ton, and the additional cost at the present time, I was told, is 20 cents, that is for the present mining cost—royalty and other more remote charges to be added.

The ore is mixed slightly with sand which reduces the percentage of iron and increases the amount of silica. I made an average of 16 analyses of ore that had been sampled and shipped this season, and this proved to be iron, 59.41%, silica, 7.66%, phos. .038%.

M. H. Brand, President; G. E. Tarboll, Secretary and Treasurer and General Manager, 377 Broadway, Milwaukee, Wis.; D. A. Bennett, Superintendent, Bessemer.

The new buildings, comprising engine house, shop, change house, dwellings &c., give the location a much improved and prosperous appearance. A transfer in ownership was made on the 25th of January last, the Anvil Iron Mining Co. selling all its property to the Anvil Mining Co. The mine produced in 1887, 10,076 tons of ore.

East of the Anvil there is no other mine that has produced any ore for market until

SUNDAY LAKE

is reached, a distance of upwards of three miles. From the Anvil mine the ground descends steeply for half a mile across the west half of Sec. 13, to

the Black River, a stream, the main body of which runs north and south, cutting through the Grange. At about the north quarter post of Section 13, the stream makes a junction with a branch running westerly from Sunday Lake. After crossing Black River there is a decided change in the formation, mainly apparent through the absence of the conspicuous foot wall belt of quartzite, which, until this point, has uniformly held easterly from the west end of the range.

Between Black River and Sunday Lake a great amount of exploring work has been done and many locations made, and in the aggregate much money has been expended; but at none has ore been found in quantity sufficient to constitute a mine. At the Mikado and a few others they have ore, but have found no large body of it. All effort has been discontinued for the present, at least, at every one of these mines, except a slight tendency to keep on at the Mikado and the Pilgrim.

At many of these mines, The Iron Prince, Ironsides, Norway, etc., they have jasper mixed with a little ore, occasionally a small pocket of clean ore but not enough to be of any commercial value. So that east of the Anvil the first mine to produce ore in appreciable quantity, is

THE BROTHERTON,

which is holding its own admirably. The Brotherton is not a large mine, but proves to be a good one, having a fair amount of ore, of the best quality.

The company holds on a lease the N. $\frac{1}{2}$ of the S. E. $\frac{1}{4}$ of Sec. 9, T. 47, R. 45. The property is fractional on Sunday Lake, the southwest corner of the land being covered by water.

There are three shafts which are 500 feet apart, and all are worked and are supplying ore. The west shaft, No. 1, is down 210 feet to the 4th level; two levels below the depth of one year ago. The shaft is sunk in the rock between two deposits of ore, called the north and the south veins; in the latter, in the 3d level, they have gone west 500 feet to the margin of the lake, and in so doing encountered a bar of rock which, for a time, caused the suspension of work in this direction; but, it being determined to push on, they were soon rewarded for their efforts by coming into a fine body of ore, which afterwards continued and still exists at the west end. But as the ground descends from the collar of the shaft to the west, it is deemed best to discontinue in the present level, and go under the lake in a lower level.

The length of the ore is about 350 feet, with a width of from 20 to 40 feet. The shaft has been sunk 60 feet further, and they have already begun to drift west. They are also driving a cross-cut north to intersect the north

vein, to see if further west than they have gone in the north vein, there is any important amount of ore.

Work in the north vein was discontinued in rock.

No. 2 shaft is also between two deposits and is 160 feet deep. The cross-cut from the shaft to the vein is 20 feet, and there is opening all the way to No. 1, 500 feet west. The ore for 200 feet in length is 12 to 15 feet wide, and in places 30 feet, and seems likely to hold its own at greater depth.

No. 3 is on the high ground, 500 feet east of No. 2, and is 175 feet west of the east line of the land. The ore body in No. 3 is about 300 feet long, and 15 to 20 feet wide, the best ore in the mine, and it is costing \$1 per ton to mine it.

They work the mine so as to take out all the ore and let the top come down, using only light timbers.

Capt. Bawden is a good miner and is doing the work safely and cheaply. Few mines are getting their ore more cheaply than the Brotherton.

The following analyses of average samples of the ore show its quality:

No. 1	-62.23 %	iron.	6.86 % s	ilica.	.034	%	phos
No. 3	-66.47 "	66	2.07 "	66	.036	66	66
No. 3	-66.82 "	66	2.04 "	66	.036	66	66
No. 1	63.80 "	66	4.50 5	66	051	66	66

All the water is pumped from No. 1 shaft by a No. 9 Knowles.

The other matters about the mine remain as stated in my last report. The mine produced in 1886, 8,880 tons, in 1887, 21,721 tons.

Joseph Sellwood, President, Bessemer, Mich.; Richard Bawden, Superintendent, Wakefield, Mich.

THE SUNDAY LAKE MINE

joins the Brotherton on the east; in fact the No. 3 shaft of the latter is opened into the Sunday Lake; both mines are working in the same deposit.

No. 1, the west shaft, is down to the 5th level, 100 feet deeper than it was a year ago, being now 250 feet deep. They are now opening the 5th level and it is claimed that the ore is improving in quality. When I was in the mine a year ago I found a good deal of sand rock in the ore; in this respect the mine has improved, the ore being cleaner than formerly.

They are troubled a good deal with water and the new company has not yet got matters in perfect shape, but apparently the mine is improving. There is more encouragement for ore than existed formerly. In fact Capt. McLeod states that they have a body of ore 650 feet long, 20 to 35 feet wide, and that at No. 3 shaft the ore is 45 feet wide. The ore runs from the west

line to a distance of 150 feet east of No. 3 shaft. No. 1 is 80 feet east of the line and No. 2 187 feet east from No. 1.

The company is now sinking No. 3, the east shaft, which is about 200 feet east of No. 2.

At my last visit I did not go underground but felt satisfied of the improved character of the outlook.

The Sunday Lake mine was until recently one of the so-called Moore & Benjamin properties, but through the failure of the proprietors to meet their obligations the mine has reverted to the fee owners, Messrs. Geo. M. Wakefield and Henry Fink, of Milwaukee.

The company is working a force of 50 men and mining and shipping 100 to 120 tons of ore per day—June, 1888.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886	14,270	1887	18,138
Total			32,408

Duncan McVichie, Superintendent, Wakefield, Mich.; John McLeod, M'g Capt.

THE IRON CHIEF MINE,

owned by the same parties that hold the Sunday Lake, joins the latter on the east. It is in low ground, very wet, and is not at present worked. The shaft was only 100 feet deep and the ore which bad been found was exhausted. It is possible that by sinking deeper better results will be obtained. It is the intention to proceed with this work at a future date.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886	9,500	1887	2,250
Total			11,750

D. McVichie, Superintendent, Wakefield, Mich.

East of the Iron Chief, half a mile, in the W. $\frac{1}{2}$, S. W. $\frac{1}{4}$, Sec. 11, 47, 45, is

THE PITTSBURGH,

a property that has been explored for about a year with, it is thought, a fair prospect of finding ore enough to make a workable mine. Mr. Dan Kloeck-

ner and others of Hancock, Mich., I think, are parties chiefly interested. Capt. M. L. Tallon, Wakefield, Mich, has charge of the work.

THE COMMERCIAL

joins the Pittsburgh on the east, being the E. $\frac{1}{2}$, S. W. $\frac{1}{4}$, Sec. 11, 47, 45. These properties promise well; the indications are good for the developing of ore sufficient in quantity to be of commercial value. The quality of the ore that has been found is first-class.

People are not so ready to concede the existence of a large body of ore, even where the indications are unusually good, as they were a year or more ago.

Contiguous with these properties and equally favorable is

THE ECLIPSE.

There are also other locations west in Sec. 12, but there is not much doing at any of them just now, May, 1888.

WAKEFIELD GOLD DEPOSITS.

Quite a little has been said and printed relative to the gold and silver bearing deposits found at

THE WASHBURN,

about $2\frac{1}{2}$ miles southeast from Wakefield, to wit, in the N. E. $\frac{1}{4}$ of Sec. 23, 47, 45, and adjoining properties. It is stated that Minneapolis and St. Paul parties are preparing to work here, systematically, for the precious metals; that their examinations by persons qualified to decide have proved entirely satisfactory.

Capt. D. F. Strobeck, Superintendent, Washburn Mining Co., Wakefield, Michigan.

THE PILGRIM,

just west of Wakefield, is still explored in a small way, but no body of clean ore has been found yet, and a party is still boring with a diamond drill south of the village, but as yet with indifferent success.







DESCRIPTION OF BLAST FURNACES.

THE SPRING LAKE IRON CO.'S

furnace at Fruitport, in Muskegon county, has an excellent record. The stack is 46 feet high, and diameter of bosh 10' 8". The wood used for charcoal is \(^3\)4 hard, \(^1\)4 soft. The coal weighs 20 lbs. to the bushel of 2,748 cubic inches.

For the sake of comparison, I give the record for three years:

Record of Fruitport Furnace.	→ 1885.	1886.	1887.
Bushels of charcoal used	1,444,675	1,610,850	1,721,330
Gross tons of ore used	28,684	29,551	31,432
Gross tons of limestone used	386	431	468
Number of tons of pig-iron made	17,217	17,776	18,381
PARTICULARS.			
Number of charges run	57,787	64,434	
Number of bushels per ton of iron made	84	90%	931/4
Per cent of yield of ore in the furnace	601/4	60	58
Number of pounds of limestone used per ton of iron	50	541/3	57
Number of days run	321	324	347
Average daily product	53.63	54.85	53
Temperature of hot blast	900	800	700

The increase in the number of bushels of charcoal used in the past year is accounted for by the superintendant, on the ground that the furnace has only lost 100 days in three years' time, and they find it more difficult to get up the requisite degree of heat now than formerly. The hot blast ovens are out of repair, and naturally leak somewhat. This is shown by the falling off in the temperature of the hot blast.

J. C. Ford, Sec. and Gen'l Supt.

BANGOR FURNACE,

also operated by the Spring Lake Iron Co., has the following record from June 1, 1887, to Dec. 31:

No. days run	204
No. bushels charcoal used	866,775
No. tons of ore used	14,206
No. tons of limestone used	281
No. tons of pig iron made	8,361
No. bushels coal per ton of iron	103
Yield per cent of ore	59
Pounds of limestone per ton of iron	75
Average No. tons of iron made per day	41
Lameroux, Supt., Bangor, Mich.	

D. C.

The stack is 43 feet high and 91 feet bosh.

THE VULCAN FURNACE CO.

has a well equipped furnace at Newberry, in the Upper Peninsula. The stack is 53'x10'8".

No. days run in 1887	276
No. tons of pig iron made	11,854
No. bushels charcoal used	1,247,977
No. tons of ore used	21,834
Yield of ore in furnace	54 3-10%

The ore used were L. S. mine, Suffolk, Detroit, Wetmore, Marquette, Michigamme, Cliff and Salsbury.

Royal A. Jenney, Superintendent.

THE ELK RAPIDS FURNACE

was in blast 314 days in 1887, in which time it made 14,888 tons of pig iron, an average per day of $47\frac{1}{2}$ tons.

H. H. Noble, General Manager.

ANTRIM IRON CO.

furnace at Mancelona, Mich., produced in 1887, 16,241 tons pig iron.

No. days in blast, 351.

Daily average, 46½ tons.

No. bushels charcoal used, 141,288, 20 lbs. to the bushel.

No. bushels charcoal used per ton of iron, 87.

Limestone per ton of iron, 183 lbs.

Average yield of ore in furnace, 60.70%. E. Fitzgerald, Manager.

THE GAYLORD IRON CO.

operates a furnace at Detroit. It was built in 1856; is a stone stack 40'x9'. The following is its record for 1887, kindly furnished me by Mr. N. Wood, Clerk of the Co., Wm. Gaylord, Treasurer:

No. days run 1887	300
No. tons pig iron made.	
No. tons iron ore smelted	11,146
No. bushels charcoal used	617,250
No. bushels charcoal used per ton of iron	91.3
Average yield of ore in furnace	60.6%

THE UNION IRON CO.'S

furnace in Detroit has the following record for 1887:

No. of days run.	312
No. of bushels of charcoal used—(20 lbs to bushel)	797,579
No. tons of ore used	14,592
No. bushels charcoal used per ton of iron	91
Yield of ore in the furnace	59.9%
Product of pig iron	8,753 tons
Wm. Gerhauser, General Manager.	

PIONEER FURNACES

owned by iron Cliff Co., Negaunee, Mich.

There are two stacks. No. 1, 52'x10', built 1858. No. 2, 56'x9', built in 1859, re-built in 1877.

Only one stack operated, in which were made 18,787 tons of pig iron in 1887. The best work done was during the week ending February 11, 1888, when No. 1 stack turned out 458 tons of pig iron, being 65 and three-sevenths tons per day, using 94 bushels of charcoal to the ton.

GOGEBIC FURNACE

located at Iron River, Mich., John Reis, General Manager.

The stack is 56'x11', went into blast in 1886, and was subsequently burned and rebuilt. I have only the record since October, 3,700 tons of ore, using 90 bushels charcoal per ton, 35 kilns, hold 50 cords average. The furnace is in a fine hard wood section, also conveniently situated for obtaining its ore

cheaply, but they do not seem to have made suitable provision for the charcoal supply yet.

EUREKA IRON AND STEEL WORKS CO.

has two stacks at Wyandotte, No. 1, 50'x12', rebuilt in 1885. No. 2, 45'x9', built in 1863.

Record for 1887. Days run	256
No. tons of pig iron made	12,484
Bushels charcoal used	1,238,445
Average furnace yield of the ore	60%

J. S. Van Alstyne, Agent.

DEER LAKE IRON CO.'S

furnace, near Ishpeming, was in blast in 1887–336 days, making $10,165\frac{1}{2}$ tons of pig iron.

W. H. Rood, President.

THE JACKSON IRON CO.

had one of its furnaces at Fayette, Delta county, in blast 320 days in 1887, during which time there were made 13,325½ tons of pig iron, using 1,463,144 bushels of charcoal. The average weight of charge was 950 lbs., and the yield of the ore in the furnace was 60%.

Wm. Pinchin, Superintendent.

MARTEL FURNACE CO.

operated its fine furnace at St. Ignace, in the upper peninsula, 200 days, making in that time 10,830 tons of pig iron, using 87.5 bushels of charcoal per ton of iron made. The per cent of yield of ore was 58.6 The furnace was built in 1881, is 53' high, $10\frac{1}{2}$ ' diameter of bosh, 2 Whitwell hot blast stoves each 60'x15'. Use Mathews retorts for making the charcoal.

W. B. Vance, Secretary and Treasurer.

THE PINE LAKE IRON CO'S. FURNACE "CHAMPION,"

at Ironton, Mich., was in blast during 1887 for 190 days, producing 10,342 tons of pig metal, charcoal car-wheel iron. The furnace only runs in the summer, will go into blast again at the opening of navigation.

H. Duvall, Secretary, 92 Dearborn St. Chicago.

DETROIT IRON FURNACE CO.

Furnace in Detroit; stack $52'x10\frac{1}{2}'$; built in 1870 as a Bitumenous furnace, made into a charcoal in 1879. Iron made in 1887, 15,272 tons, in 330 days. E. C. Wetmore, Secretary.

Table showing product of Michigan Blast Furnaces for the years given:

Name of Company.	1884.	1885.	1886.	1887.
Eureka Iron and Steel Works, Wyandotte	6,000	10,904	11,668½	12.484
Gaylord Iron Company, Detroit	7,200	4,803	8,093	6,760
Detroit Iron Furnace Company, Detroit	6,205	13,619¾	6,741	15,272
Union Iron Company, Detroit	8,000	3,303	6,000	8,753
Peninsular Iron Company, Detroit	7,200	7,439	5,263	
Bangor Furnace Company, Bangor		6,8911/2	12,941	8,361
Elk Rapids Iron Company, Elk Rapids		16,0771/	17,434%	14,888
Spring Lake Iron Company, Fruitport		17,217	17,768	18,381
Jackson Iron Company, Fayette		8,456	10,581	13,325½
Vulcan Iron Company, Newberry		11,426	17,360	11,854
Deer Lake Iron Company, Ishpeming		9,2451/2	10,8981/2	10,165½
Iron Cliff Company, Negaunee		15,718	11,079	18,787
Antrim Iron Company, Mancelona			9,414	16,240
Pine Lake Iron Company, Ironton			5,070	10,342
Martel Furnace Company		****	7,666	10,830
Gogebec Furnace Company				3,700
Total		125,190	148,952	



GYPSUM.



GYPSUM.

For particulars relating to this important industry reference is made to the Commissioner's Report for the year 1881, wherein I have described the deposits, mills and quarries fully.

TABLE showing the Amount of Land and Calcined Plaster produced in Michigan, for each year since 1866, and the aggregate in previous years.

Years.	Land Plaster, Tons.	Stucco-Barrels 300 lbs. each.
ears previous to 1866	100,000	80,000
866	14,604	
867	17,439	
868	28,837	34,996
869	29,996	41,187
870	31,437	46,179
871	41,126	48,685
872	43,536	59,768
873	44,972	82,457
874	39,126	82,449
875	27,019	61,120
876	39,131	64,386
877	40,000	55,000
.878	40,000	48,346
879	43,658	50,800
880	49,570	106,004
881	33,178	112,813
882	37,821	135,655
883	33,225	201,138
.884	27,888	156,677
.885	28,181	141,575
	29,398	153,274
1887	28,794	170,148
	848,936	1,856,614

TABLE Showing the amount of Land Plaster and Stucco produced by the different Companies in Michigan, in the Years indicated.

	Numbe	Number of Tons of Land Plaster produced by Michigan Companies.	is of Lai	nd Plast	er produ	ced by	Michiga	n Comp	anies.	Nur	Number Barrels of Stucco	rrels of	Stucco	produc	M vd be	ichigan	produced by Michigan Companies.	lies.
Name of Company.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Godfrey & Bro.	9,117	9,000	6,423	6,080	5,682	4,593	4,467	4,560	3,937	1 1 1	23,000	27,500	30,274	37,000	30,433	30,942	28,273	30,284
ter Co	8,970	12,000	6,375	7,512	5,013	3,044	4,143	3,832	4,517	-	23,500	20,400	32,854	40,000	24,390	26,498	28,627	32,386
Wyoming Mills	7,000	10,000	6,093	6,801	4,400	3,052	4,059	3,714	3,585	-				12,000	13,108	11,193	11,327	15,175
Union Mills	4,500	7,500	6,716	8,298	5,500	3,185	3,663	3,687	3,102	:	35,000	34,913	23,074	30,000	23,176	15,654	18,027	21,979
D. Noble & Co	10,585	9,570	6,572	6,037	4,000	3,202	3,900	1,947	3,106	:	24,504	30,000	27,893	38,000	30,288	26,344	28,760	34,235
Smith, Bullard & Co	1,586	1,500	1,000	2,993	4,600	4,122	4,316	6,039	5,589	1			11,817	30,961	23,961	20,797	27,113	21,152
Alabastine Co		1	1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	4,032	069'9	3,606	5,608	4,958	;	,			13,172	11,321	10,147	11,147	14,934
Geo. H. White & Co.	1,900	1 2 0 0 2 1	1 6 8 9 9	1 9 0 0 0 5 5	3 4 7 8 9	2 2 3 8 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2 0 1 3 4 4 8	1 6 9 8		2 2 1 2 2 2 2	1 1 6 9 1 1	5 2 9 3 4 9	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 6			b 6 6 8
Totals	43,658	49,570	33,178	37,821	33,225	27,888	28,181	29,398	28,794		106,104	112,813	135,655	201,133	156,677	141,575	153,274	170,145

SALT.



SALT.

The salt production of Michigan, as reported to me by the State Salt Inspector, for 1887, was as follows:

Fine.	Packers.	Solar.	Second Quality.	Common Coarse.	TotalProduction. Barrels.
Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	
3,198,070	19,385	13,903	73,905	17,378	3,944,309

Fine salt in bulk, 621,668, making total production as above.

The average price was 68 cents. There were 285 wells pumped.

The following table shows the amounts of the various grades of salt inspected in Michigan since 1869, the first year of the establishment of the State inspection law:

Year.	Fine.	Packers.	Solar.	Second Quality.	C. coarse.	Total.
869	513,908	123,908	15,264	19,177		561,288
870	568,326	17,869	15,507	19,650		621,352
871	655,923	14,677	37,645	19,930		728,178
872	672,034	11,110	31,461	19,876		724,481
878	746,702	23,671	32,267	20,706		823,346
874	960,757	20,090	29,391	16,741		1,026,976
875	1,027,866	10,233	24,336	19,410		1,081,856
876	1,402,410	14,233	24,233	21,668		1,462,729
877	1,590,841	20,839	22,818	26,818		1,660,997
878	1,770,361	19,267	33,544	32,615		1,855,884
879	1,997,350	15,641	18,020	29,027		2,058,040
880	2,589,037	16,691	22,237	48,623		2,676,588
881	2,673,910	13,885	9,683	52,821		2,750,299
88 2	2,928,542	17,208	31,335	60,222		3,037,317
883	2,828,987	15,424	16,735	33,526		2,894,672
884	3,087,034	19,308	16,957	38,508		3,161,806
885	3,230,626	15,480	19,840	31,428		3,297,408
886	3,548,731	22,221	31,177	71,235	3,893	3,677,257
887	3,198,070	19,385	13,903	73,905	17,378	3,944,309
Total						38,600,77
alt manufactured prior to 1869						3,782,11

The capital employed in the Michigan industry is estimated at \$2,150,000; the number of hands employed averages 5,000, and they are mostly men, and the wages paid \$550,000.

The average price of Michigan No. 1 fine salt per barrel for a series of years is as follows:

Year.	Price Per Barrel.	Year.	Price Per Barre	el.
1866	\$1 80	1877	\$	88
1867	1 77	1878		88
1868	1 85	1879	1	08
1869	, 1 58	1880		78
1870	1 32	1881		88
1871	1 46	1882		76
1872	1 47	1883		8.
1873	1 37	1884		78
1874	1 19	1885		70
1875	1 10	1886		6.
1876	1 05	1887		6

The great majority of the "blocks" are run in connection with a lumbermill, and hence the cost of production is very small.

The cost of salt "blocks," for the production of, say 300 barrels per day, is about \$30,000, including the boring of the wells, the depth of which ranges from 650 to 1,100 feet. The manufacture of salt is, briefly, as follows: The brine is pumped by steam from the wells and stored in cisterns, where it is allowed to stand for four hours. A small quantity of a mixture of lime and water is then thrown into it to settle the iron in the brine. As the lime sinks it carries the iron with it, leaving the brine perfectly clear. It is then carried off into a settler provided with steam-pipes, where it is heated to a point of saturation. It is next drawn into the grainers, which are about 150 feet long, 10 to 12 feet wide, and 16 inches deep, and provided with five rows of three-inch steam-pipes. As the brine becomes heated it causes the salt to crystallize and come to the surface. Then it is raked to the sides of the grainer and lifted out with shovels and placed on platforms, where it is allowed to drain for about four hours, when it is wheeled into bins for storage where it must remain, pursuant to the State law, for at least fourteen days before being packed for sale. This is ordinary salt and is used mostly for curing meats, fish, etc. It is known as No. 1 fine, and the bulk made at Saginaw is of this quality.

COAL.



COAL.

I have written up the Michigan coal interests, in the State Commissioner's report, 1881, especially. I find no important changes. Some "banks" have been exhausted and abandoned, and new shafts opened. It not unfrequently happens that there is an excitement awakened in some locality over the alleged discovery of a valuable coal vein in the vicinity. But investigation generally proves that the deposit, if one there be, is of little or no practical value. Coal is found in Michigan in many places, but it is of too poor quality. It is light and friable, sometimes slaty, making a good deal of slack. The deposits or coal seams are thin, exceeding nowhere 3 to 4 feet in thickness; generally much less. The roof is frequently poor, and the ground wet. Some of the best coal shafts that have been opened have proved too wet to work with any profit. The formation is liable to be curved and faulted, which adds to the difficulty in getting rid of the water.

The coal is said to be excellent in making steam, and is liked for locomotive boilers; but the difficulty in making contracts with the railroad companies has been the uncertainty of the product, arising mainly from the difficulty which the companies have in securing and holding their laborers.

The mines are so low and wet that men do not like to work in them; and as the mining is done on contract, the miners must understand how to work to advantage, or they cannot make wages.

They must learn how to mine here, as new miners cannot take the place of experienced ones.

Jackson and Corunna are the only coal mining points of any importance; at the latter, several new shafts have been opened in the past year, 1887. One near Trumbull Station, five miles west of the city, in which they commenced taking out coal in July last, having previously, in the same year, abandoned, is exhausted, the Merrill shaft, half a mile north of the city.

The Bennett Sewer Pipe Co. has opened a shaft and mines coal exclusively for its own use, for fuel in its manufacture of sewer pipe, etc.

The Spring Arbor Co. is also a new concern at Jackson. The Standard Coal Co. and the Star have been mining since 1885.

At Corunna there is nothing new, but at Grand Ledge considerable impetus has been given to the business. Mr. H. J. Stark opened a mine there in September last, and has been getting it into shape to work. He reports a product to the close of the year of 64 tons.

_	Years previous to 1877.	1877.	1878.	1879	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Williamston							10,454	884			1,000	100
Jackson mine Corunna Coal Co		67,147	61,785 22,537			7,060	8,624	9,000	8,000	10,000	15,975	8,000
Other mines R. H. Emerson		1,500	1,000	800							1,000	
& Co					66,780	61,666	60,103	40,412	13,712	15,553	21,363	13,230
Eureka Coal Co. Michigan Coal					30,000	37,477	25,000					
Co					20,021	23,987	25,000					
Porter Coal Co.						~	6,158	21,000	15,000	13,000		
Star Coal Co Standard Coal										5,123	5,821	7,3331/4
Co. Spring Arbor										15,000	4,743	5,000
Coal Co. Bennett Sewer-												500
pipe Co H. J. Stark, G'd												2,317
Ledge												64
Total	350,000											

GOLD.



GOLD.

Quite an impetus has been given to the interest felt in the Michigan gold deposits in the past year through the discovery of the extraordinary rich rock found on the Lake Superior Company's land. This company sank a shallow pit in a quartz vein at a point 275 feet west of the east line of the N. E. \(\frac{1}{4}\), N. W. \(\frac{1}{4}\), Sec. 35, 48, 28.

Some of the quartz obtained in this pit assayed upwards of \$40,000 in gold to the ton of rock. It is full of free gold. I saw a large piece that, crushed by a heavy blow, the fragments held together by the gold which the rock contained. Some of the quartz may be seen at the company's office in which are seen "strings of gold" and particles of the size of a shot and of a small pea. Nothing further was done. The shaft was covered up and the ground about it enclosed with a high fence so as to debar all access to the pit. What action the company may conclude to take is not known.

Since the foregoing was written the Lake Superior Iron Co. has arranged to work its gold deposit. The shaft has been uncovered and the company is sinking it deeper.

The company is working 6 men at the shaft now, June, 1888. At a depth of 22 feet a very rich pocket was encountered from which several hundred pounds of rock have been secured that will yield, it is estimated, \$10,000 in gold, or at the rate of \$40,000 to \$60,000 to the ton.

THE MICHIGAN GOLD CO.

holds the "40" adjoining the above on the east, that is the N. W. 4, N. E. 4, Sec. 35, 48, 28. The officers are Jas. Pickands, President; S. L. Mather, Secretary and Treasurer, Cleveland, Ohio; F. P. Mills, Agent, etc. Richard Trevarthen, Superintendent. Capital stock \$1,000,000, divided into \$40,000 shares.

The mineral is quartz vein matter in a formation of diorite. The main vein is the continuation east of the one in which the rich pocket was found on the Lake Superior Co.s' land. The mine runs east and west and Mr. Mills

has uncovered it across the property, 1,320 feet. Not only has he trenched this entire distance, but also he has dug a trench along the line between the properties north and south 600 feet, and at several other points has also trenched north, at one place a length of 610 feet. Wherever in these trenches a quartz vein is uncovered it has been followed in the same manner east and west until it disappeared.

The company has opened several exploring shafts on the property. No. 1 of these is 160 feet east of the west line, being thus 435 feet east of the Lake Superior Co.'s "rich find." No. 1 is, Dec. 10, 60 feet deep. At surface the vein was split, the two parts separated by 7 feet in thickness of diorite, but at the bottom the veins are united, making the vein 8 feet wide; the shaft is 5 feet wide and dips south 80°. The vein is continuous but is split a portion of the distance. A recent assay of rock taken from No. 1 gave \$1,400 per ton. On the main vein south vein are 3 shafts.

No. 5 is 360 feet east of No. 1, and is about 15 feet deep. The quartz has a width of $2\frac{1}{2}$ feet. No. 2 is idle, the vein is 8 feet wide. No. 3 is 120 feet northeast of No. 2, on a separate vein. No. 4 is 300' feet N. and 200' E. of No. 1, also on a separate vein and is about 15 feet deep. All the work is of an exploratory character. The company is a strong one; the property will be thoroughly tested, and if found sufficiently favorable, it will be worked to the fullest extent.

There is litigation pending regarding the matter of the lease of the land, another party than the Michigan Co. claiming to have leased it.

There are other gold explorations in progress.

SECTION 36.

Mr. A. B. Miner and others are examining a vein of quartz which they report to contain gold in paying quantity. Also in same section Mr. Grummett has sunk a shaft 40 feet.

THE ROPES GOLD MINING CO.

is deserving of a good deal of credit in one respect, at least, for its persistence in continuing to work, even under some very discouraging conditions. The experience of this company, the facts disclosed by its work, are of great value to the country. The company has been only moderately successful, but it is seen that it might have been far more so if the conditions had been better understood, and the affairs of the company more thoroughly managed, characterized by greater experience, and closer supervision in the practical work. For instance, the twenty-five stamps have, until recently, only crushed 18 to 20 tons of rock per day; now they are manipulating 1,000 tons per month. They have had to learn how to do it. It has been up-hill work from the beginning. There was, of course, plenty of rock, but the mining has been limited to the capacity of the mill; that is, to the amount of rock that they could treat in the mill.

The company will be able soon to dispose of double the quantity of rock that it can now. They have the building nearly completed for a second mill, in which will be placed twenty stamps, which will increase the number to forty-five, and they will work up 70 or 80 tons per day. No. 1 shaft is sunk nearly to the 8th level, about 450' down. The 7th level has been opened west 100 feet. There is gold-bearing rock in this level for a width of 90 feet, though the true quartz vein seems to be about 8 feet wide; 360' east of No. 1 they have begun the sinking of another shaft which, at this writing, is 60 feet deep. This, so far, seems to be a narrow vein.

In the bottom of the shaft some rich rock has been found, which assays \$80 per ton. Probably this would not be the mill average, but it all seems good. This fact is certainly an encouraging feature. The best rock they have ever obtained in the mine, was in the 1st level, and to find it still rich in the bottom at 450 feet down, is important. The Ropes is in a fair way of success, with the new mill in operation, with rock that averages a good percentage of gold, it only needs enterprise and efficient management to make it a paying mine.

Even in the small way in which it has been operated, the mine has yielded \$115,000 in bullion.

There is a plan on foot to sell a controlling interest in the mine, placing the shares disposed at \$3. I understand that the matter is likely to be consummated, and will be if enough of the stock is furnished. The company that now controls the Ropes is lacking in funds. The main stockholders have faith enough in the mine, but have no money to "push things." I think that the Ropes can be made a paying mine, and ultimately will become so.

It seems to have rock enough for far more extensive working, and it is favorably situated for economical working.

The following is taken from the company's report:

The number of feet of winzes sunk is 50; number of feet of drifting, including cross-cuttings, 352.

To recapitulate the data pertaining to ore bodies:—We have in the Curry shaft, from the sixth level to its present depth, a continuous body of rich ore—at points of extraordinary richness—as at a depth of 35 feet below the seventh level to its present depth, covering the entire width, 10 feet. On the second level, east of the shaft, a fine stope of rich ore is being broken down on the north vein. To the south, 12 feet, is a fine vein

of quartz, the intervening slate and quartz being good milling ore. West of the shaft is an 18 to 30-inch stope of good ore.

On the third, fourth and fifth levels, to the east, are still good reserves of rich ore standing between the shaft and that stoped out from the winzes; both to the north and south of the stoped out bodies of rich ore, in places stand large bodies of low-grade ores. To the west of the shaft, on these levels, no stoping of any account has been done; the veins being smaller they have been left for future work.

On the sixth level the lode from here down stands in its entirety (barring the drift and winze). The bodies here are large and of good quality, as shown by the shafts and drifts on the seventh. The ore bodies on the sixth and seventh levels, west of the shaft, are by far the best encountered, extend the farthest west, and would seem to indicate that the ore shute of 300 to 400 feet is pitching in this direction.

With regard to the amount of ore in sight, in the several levels of the mines, we concur in the estimate of Capt. Williams, that it is not less than 80,000 to 90,000 tons.

At the Ely shaft, while small veins of rich gold quartz are frequently cut in the slate dike, the existence of a rich, 12-inch vein of ore at the surface in the country, close to the contact, and a thin vein of gold quartz at the contact, no body of any account of gold-bearing material has been encountered until the last 20 feet, when considerable low-grade rock has come in. It is confidently expected, on reaching the depth of the third level, where cross-cuts will be run north and south to the foot and hanging of the dike, and the drift extended west, to connect with the old workings, ore bodies of large size will be encountered.

By reference to the last annual report, it will be seen that the opinion was ventured, being based on the favorable geological conditions of the sixth level of the hanging country dipping away flatly from the foot, that below it would be the repository of valuable ore bodies. The rich bodies of ore developed by the work below the sixth level, fully corroborate the views expressed, and these views are shared in by experts who have visited the mine the past year. Every indication gives promise that the lode will continue in depth in all its strength to a point beyond which it cannot profitably be mined. The diversity of minerals that have hitherto characterized the deposits still continues, and we enumerate: free gold, native silver, gray and yellow copper, iron pyrites, chromic iron, a little galena, zinc and antimony, at points in croppings of dolomite, nickel and cobalt occur an array of minerals giving great strength and permanency. The gold continues as free in the great bulk of the matrix as near the surface.

By reference to the secretary's report, you have given the result of the year's product, and but for a knowledge of the fact that the mine and mill are capable of achieving, as proven by the past, the same might be regarded as unsatisfactory.

That the favorable statement of the condition of the mine embraced in last year's report gave reason to expect higher results, is true. To a combination of circumstances is the failure due.

The chief factor was the continual milling, for a number of months, of low-grade ore alone from the large stope on the fifth level. It was not from a paucity or quality of ore in the mine. Some of the stopes of good ore had become inaccessible, others neglected; sinking of the shaft, which had furnished good ore, had ceased. To these facts, coupled with unskilled labor in the mill, are attributable the low results. The largely increased production (after the several stopes in the mine were got at) \$1,200 in January and \$1,500 in February, over December, bear out the statement. It required some time

to make accessible some of the stopes and produce good ore; now that all are in good shape, continual paying results are looked for.

The capacity of the mill has been largely increased the last half of the year by improvements introduced, and the adoption of methods found in general use in the mills in the Black Hills during a sojourn there of three months.

The rock crushed the past five months has averaged 1,028 per month, against 700 to 800 tons per month previously. The loss in tailings has ranged from \$0.90 to \$1.50 per ton.

The average number of men and miners employed in and about the mine is 42; number of men about the mill, 7.

The number of tons of rock crushed, 10,187; yield per ton, per secretary's report, \$3.42. The cost of milling the ore for the past four months has been \$1.20 per ton, a large reduction from that of any previous period.

Acting in accordance with the expressed views of a majority of the shareholders at the last annual meeting, the directors, in July last, levied an assessment of fifty cents per share on the capital stock of the company, for the purpose of erecting additional reduction works. The call was responded to with great promptness, and the management at once set about securing proposals for the necessary material and machinery.

Satisfactory bids were received from Frazer & Chalmers, of Chicago, Ill., for its completion January 1, and the contract was awarded them.

The additional plant consists of a 6x16-foot boiler, a 235 horse power Corliss engine, 20 heads of 850-pound stamps, with all the auxiliary machinery, parts and pieces in such plants necessary for a complete mill. A new building, 40x85 feet, and vanner room, 36x84 feet, are up and completed. The mill will accommodate 20 stamps more (40 in all) whenever needed; all of which, together with the present mill of 25 stamps, the engine will easily run.

A new boiler house, 49x66 feet, with corrugated iron roof, a dwelling house two stories, 14x20 feet; a supply house, 18x26 feet, and a new foundation and floor to the vanner room have been put in, comprising the surface improvements for the year.

To insure the greatest economy in running expenses for the future, a large engine and shafting were purchased, so that both mills could be run from the same center. It has cost \$4,000 to \$5,000 more to begin with than it would have just for engine to run the new mill, but figures show that the running expenses in a year or so will fully compensate for the additional outlay.

With increased reduction works came an increased demand for water, the present source of supply being only adequate for the present plant. The only available source of supply being the Carp river, some 5,000 feet east of the mill, and 45 feet below the dam, the ground was examined, and it was thought feasible to dam the stream and utilize the power to do the pumping. The matter having been presented to Director W. H. Rood, President of the Deer Lake Company, he kindly granted permission to build a dam on their land. Estimates, by a competent engieeer, showed that there was sufficient water, with the 5 to 6-foot head he could get, to force the required supply into the dam with a turbine wheel. Work was begun in October, the pipe (6-inch-wood) laid and, the wheels set in position in December. The wheel is a 20-inch Victor turbine, and a $5\frac{1}{2}$ -inch duplex Knowles pump completes the plant, which commenced pumping February 13. The first cost cannot exceed that of a steam plant, and the running expense will be merely nominal, effecting a saving of \$2,000, to \$3,000 per annum over steam.

The cost of the several improvements enumerated is given in the secretary's report.

It is expected to have new mill ready to run in April. The delay in the work has been solely for want of lumber. As soon as plans were secured orders were sent in for it, but owing to the rush of building the past season, the markets far and near were depleted of the required sizes, deferring the work until snow came, when it could be got from the woods. The work has been pursued under some disadvantages on account of the delay, by throwing it into inclement weather. On the other hand, the great advantage of placing all the material, and especially the very heavy machinery, on the ground at this season of the year (at a minimum cost, and with little trouble) fully compensates for the disadvantages.

The matter of treating, by chlorination, on the ground the low-grade concentrates too poor to ship is presented for consideration at this time. The bodies of mineralized rock on the property that it may be found profitable to mill on a large scale (provided they can be treated cheaply on the spot) are practically inexhaustible. Concentrates of this character are treated in California at a cost of \$12 per ton, 95 per cent. of the gold being extracted. The principal cost of treating is for material and labor. At points where the cost is \$12 per ton, wood is \$6 per cord, labor \$3.50 per day and chemicals doubtless proportionately high. With the difference in cost of these items here and there, treatment ought to be effected here at \$8 to \$9 per ton. At these prices \$15 to \$20 can be realized on concentrates that will not pay to ship.

Regarding cost of plant, to handle 3 or 4 tons per 23 hours, figures cannot be given; it was expected to have them before this, they having been promised but not received. Three thousand to four thousand dollars is regarded as ample for plant.

With a mine that is developed to no greater extent than this, it is uncertain and precarious to predict what reward awaits the pick and drill beyond the limits of present large and rich bodies. We have enumerated and placed before you the existing conditions of your mine, mill and other property.

> J. ROPES, President. GEO. WEATHERSTON, Supt.

ISHPEMING, MICH., March 12, 1888.

SECRETARY'S ANNUAL REPORT.

March 1, 1887, last statement	\$723 74	
Rec'd on 50c assessment	40,000 00	
" for interest	222 49	
" bullion 12 months	25,939 88	
" concentrates 12 months	3,001 62	
" wood, rent, etc., at mine	196 16	
" Ishpeming National Bank	6,000 00	
Contra.		
Paid for new machinery		\$19,994 2
" labor, new mill		5,783 33
" " water works		4,048 7
" wood and coal		9,126 80
" explosives		1,323 08
Supplies		4,573 89
Labor		25,667 95
Insurance		410 50
Assaying		179 00
Taxes		590 60
Freight		898 23

Office 662 15 18 18 1 18 18 18 10 18 18 18 10 18 18 18 10 18 18 18 10 18 18 10 18 18 10 18 18 18 18 18 18 18 18 18 18 18 18 18	General expense		\$1,161 51
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Concentrates	Office supplies	125 00	
## Committee Com	February bullion	2,535 00	
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Gross concentrates 8,899 09	Product of Mine for year, March 1, 1887, to March 8, 1888.		
Sake	Gross bullion	\$26,031 57	
Number tons quartz treated for year 10,216 Average yield per ton \$3 42 Recapitulation. Gold. Silver. From statement to March 1, '86. \$29,452 11 \$3,558 59 From statement to March 1, '87. 38,499 93 4,653 92 From statement to March 1, '88. 32,338 63 2,592 03 \$100,290 67 \$10,804 54 Total Gold and silver produced \$111,095 21	Gross concentrates	8,899 09	
Recapitulation. Gold. Sliver. From statement to March 1, '86. \$29,452 11 \$3,588 59 From statement to March 1, '87. 38,499 93 4,653 92 From statement to March 1, '88. 32,338 63 2,592 03 **Total Gold and silver produced \$100,290 67 \$10,804 54 **111,095 21			\$34,930 66
Recapitulation. Gold. Sliver. From statement to March 1, '86. \$29,452 11 \$3,588 59 From statement to March 1, '87. 38,499 93 4,653 92 From statement to March 1, '88. 32,338 63 2,592 03 **Total Gold and silver produced \$100,290 67 \$10,804 54 **111,095 21	Number tons quartz treated for year		10,216
Gold. Silver. From statement to March 1, '86. \$29,452 11 \$3,558 59			\$3 42
Gold. Silver. From statement to March 1, '86 \$29,452 11 \$3,558 59	Paganitalation		
From statement to March 1, '87. 38,499 93 4,653 92 From statement to March 1, '88. 32,338 63 2,592 03 \$100,290 67 \$10,804 54 Total Gold and silver produced \$111,095 21	necapituation.	Gold.	Silver.
From statement to March 1, '87. 38,499 93 4,653 92 From statement to March 1, '88. 32,338 63 2,592 03 \$100,290 67 \$10,804 54 Total Gold and silver produced \$111,095 21	From statement to March 1, '86	\$29,452 11	\$3,558 59
From statement to March 1, '88. 32,338 63 2,592 03 \$100,290 67 \$10,804 54 Total Gold and silver produced \$111,095 21		7 /	4,653 92
Total Gold and silver produced			
Total Gold and silver produced\$111,095 21		\$100.290.67	\$10.804.54
	Total Gold and silver produced	- '	7



COPPER.



THE COPPER MINES.

It is pleasant to meet the smiling faces of those engaged in copper mining, these days. The contrast between the prosperity of the business now and what it was a few months ago, and in fact what it has been for two years past, is indeed gratifying. During the years 1885, '86 and '87, the average price at which Lake Superior copper sold was within a fraction of 11 cents per pound; but suddenly, in about December, 1887, the price advanced from 12 cents to 18 cents. More recently arrangements have been made by all the leading copper mining companies, with what is known as the French Copper Syndicate, for the sale of all the copper produced for several ensuing years at a minimum price of $13\frac{1}{2}$ cents per pound, or rather at the fixed price of $13\frac{1}{2}$ cents, with the agreement that if copper shall be worth more than this fixed amount, the excess shall be divided equally between the syndicate and the producers.

Much confidence is felt in the financial strength of the syndicate, and its ability to meet its agreement for the purchase of the copper. If carried out, as no doubt it will be, it places the mining companies in an assured position.

Their experience for the past three years has demonstrated the fact that they can produce copper, nearly all of them, for 10 cents a pound. For three years, the Atlantic, Franklin, Osceola, etc., have mined copper and sold it at an average of 11 cents, and have made a little money; but it has been too close a business; the margin is too small; they are exhausting the mines, using up machinery, etc.; in fact, borrowing of the future.

Not that they have been running into debt, but in various ways there has been a degree of economy exercised that may, no doubt, be likened to borrowing of the future:—changes and improvements, etc., that were desirable, have been put off to the future. It has been necessary "to make things do" until a more prosperous season, and thus there are deferred expenditures.

In times of depression such as the copper mines have suffered for the past three years the necessity of diminishing expenditures to the lowest possible point, creates a tendency to put off until a future season construction, repairs, opening and exploring work, etc., that ordinarily are estimated an essential part of each year's burden. With copper selling permanently at 10 cents per pound, the larger number of our copper mines could have little value. It would become with most of the companies a mere struggle for existence. The managers would find it necessary to exercise all their wits to make ends meet.

Leaving out the Calumet and Hecla, Tamarack and the Quincy, the others must have copper at more than 10 cents to be valuable mines. Some of them can produce copper for less than 10 cents, with good luck; but they need all the surplus they can accumulate to provide for future contingencies.

The metal from the Lake Superior copper mines is of surpassing value. There is none other in the world comparable with it for intrinsic purity and excellence. It is a pity that a metal so adapted to the superior purposes should be degraded to inferior uses, to the manufacture of common, cheap utensils. It is a pity that the world should not be so made aware of the superior excellence of our pure native copper that it should rank far in advance in price of the inferior foreign metal. It seems strange that Lake copper should sell at the price of Chili bars, or that Chili bars should be the standard of price in the copper market, and rank equal in price with the purest native copper in the world.

No doubt but it will be the business of the Syndicate that now controls the copper market to grade the metal according to its intrinsic value; giving to the Lake Superior copper its rightful place, and making known to the world the important uses to which this finer metal is naturally adapted. Under the control of the Syndicate, Lake copper is already selling at a higher price in Europe than electrolytic copper, a grade which our native product naturally assumes, and one to which the impure metal of South America and Spain is only brought at considerable cost.

Naturally the rise in the price of copper has occasioned a considerable increase of activity in the working of the mines previously in operation, and has caused steps to be taken to put into operation some that were idle. The low price that prevailed so long in the copper market, and the fear that it would continue, caused the suspension of work at several important mines, nearly all of which are again in operation, or soon will be, under the stimulus of the advanced price.

With copper at 13 to 17 cents a pound these mines can be made to produce at a profit under good management, and perhaps a better opportunity for resumption of work may not occur again.

Besides these there is a large number of old mines that were once largely worked, and a few with profit, that under the new order of things may be again undertaken to advantage.

Some of these old mines that have been idle for many years it is certain

are valuable; that is, they could now be worked with every assurance of success, if managed with the same intelligent skill, care and economy that characterizes the conduct of operations at other mines, which have continued to be worked.

I refer only to such as have copper bearing deposits of known magnitude but low grade. But the methods of working have so greatly advanced since these mines were shut down that, with the price that now prevails, there is reason for the hope that a much better outcome would result now than formerly.

With the rise in the price of copper, there was a corresponding rise in the stocks of the companies. Some of them have doubled in market value in a few weeks' time, and the fortunate possessors have been enriched accordingly. So that while stocks in portions of the iron region have immensely depreciated in value; in fact while they, in part, have become, in the newest of the iron ranges, practically worthless, no one need have met with any loss recently in the matter of copper stocks. For they have all advanced so greatly that the gain has much exceeded any previous depreciation in value in the stocks of all the leading mines in the district. Some of the stocks will go still higher. A few are quoted, comparatively, below their intrinsic value; some, probably, sell for more than they are worth, and will recede in price as others may advance.

At any rate there is a pleasant prospect spread out for the copper mining industry, and those engaged in it certainly needed the relief and are entitled to the good fortune which has come to them.

The laborers and miners participate in the prosperity; wages have been advanced and general good feeling prevails.

The relation existing between the men and the mining corporations in our state is most harmonious and cordial. I have taken much pains to inquire into the matter, not only in the past year, but during many previous years, and I know of no laboring men better treated or more contented than those in the iron and copper mines of Michigan. There are no strikes, no threatening of strikes, and it is very seldom in all the years gone by that a strike, of any extent, among the men has occurred.

It was charged that at the election held recently, for Congressman in the 11th district, great constraint was exercised over the men at certain mines in the iron region to practically compel them to vote as the managers wish.

The assertion of such action being taken by mine managers and of compliance by the men is all wrong. Such statements as applicable to the companies against which they were made are entirely false. I know the managers and I know the men, and I have been at the mines on election days, and I

know that the officers would not be guilty of such action, and that the men are too independent to submit to it if it were undertaken. I have observed on election days at the mines as much freedom of choice exercised by the voters, as much absence of all undue influence, as will be seen elsewhere.

I must also bear testimony to the general good order of the towns throughout the mining region of our State. Good schools, good social life, opportunity for pleasure, and for mental and moral culture exist in the chief towns, comparable on a basis of equality, with corresponding towns elsewhere. The people in the mining portions of our State average equally in all commendable qualities with those of any other portion of the State. While prohibition could not be enforced in the upper peninsula, it is a fact that the present State tax law is nearly as well observed in the older and better settled portions of that section as it is in the most orderly parts of the lower peninsula. The State law taxing the sale of liquors, has had great influence in limiting the traffic in the mining regions, and is the only State law on the subject that was not entirely ignored.

In describing the copper mines in this report I shall be brief. I have been over this matter so fully in previous reports published since 1880, that I do not deem it necessary to go over the same details now. The work in the copper mines is so systematized, is so regular and uniform that there is but little change from year to year; the mines get a little deeper from year to year. The lode usually remains about the same; sometimes a little richer, sometimes a little poorer; but such changes are usually only temporary; the average percentage is about the same one year with another. There are, of course, occasional improvements, additions to machinery, to stamp mills, etc., but on the whole the average work in the copper mines shows little change.

With the exception of the mines in the vicinity of Portage Lake, there has never been a year within the period since copper mining was begun when so little was done elsewhere in the copper range as during 1887. With the exception of the Central, all the mines in Keweenaw county were nearly idle, and up in Ontonagon very little but tribute work was done.

AT THE NATIONAL MINE

they have begun the work of erecting a stamp mill, which will contain one head of stamps. The mine will have a present capacity of 150 tons of rock per day. The purpose of the mill will be to prove the amygdaloid lode, to make sure what percentage of copper there is in the rock, and what amount of the rock they can depend on. There are fully 20,000 tons of stamp rock on hand, derived from the openings that have been made in the amygdaloid

645 3ND. LEVEL 71.0 1.0 1.0 70.6 TUNNEL MINNESOTA

LONGITUDINAL SECTION OF THE NATIONAL MINE, JAN., 1888.

Scale, 300 ft. to one inch.



in the past few years. Like all amygdaloid belts this, at the National, is variable in quality; it is rich and poor in places, occasionally making out into wide pockets of good stoping ground.

It will be remembered that the National Company has lately been engaged in driving an adit from the bank above the river east in the conglomerate vein. All this I have fully described in my last two reports. The adit is 3,950 feet in length, and gives 500 feet of "back" or of vein above the adit for two-thirds of the way. The mouth of the adit is 188 feet above the river, and about 4,000 feet east of it. The location of the new stamp mill is below the mouth of the tunnel, and will receive the drainage of the mine, which, with the water that accumulates in the valley between the bluffs, constituting a small stream, will nearly suffice for one stamp head. Capt. Parnell estimates that he may have to pump one-fourth of the water required, from the river.

The accompanying map shows the mine in the conglomerate, or mass vein, the one that has produced all the copper that made the National mine once famous. The amygdaloid is 140 feet north of the former and parallel with it, both run with the formation.

In former times when the National was a large producer of copper the two lodes were found to be connected by cross fissures which in some instances were highly rich. At the intersection of the main cross fissure with the conglomerate vein was especially good ground.

The rise in the price of copper is stimulating work at the National and Capt. Parnell is pushing things as fast as possible.

The officers are J. C. Watson, President; D. L. Demmon, Secretary and Treasurer, Boston, Mass.; Wm. E. Parnell, Superintendent, Rockland, Mich.

The National is one of the oldest mines in the state, having been started in 1848, 40 years ago. It was also one of the most profitable mines having cost in assessments only \$110,250, and returned in dividends \$360,000.

The mine has produced in toto 5,462 tons and 1058 lbs.

The product in 1887 was 12 tons 1,187 lbs.

The mill will be at the creek shaft. The mine water will be gathered into this shaft and be pumped 79 feet up into the mill. The shaft that is sunk in the amygdaloid is down to the 6th level. They have drifted in this belt 1,100 feet, and on the average it is looking favorable. Apparently it will all go to the mill.

No. 1 Amygdaloid shaft is located 250 feet from No. 2, the shaft in the Conglomerate which Capt. Parnell re-opened and re-fitted.

I understand that this No. 1 will be the main hoisting shaft, close to it will be the rock house, and thence the rock will be run to the stamp mill

2,200 feet over a graded track, $2\frac{1}{2}$ feet grade to the 100, to the head of a "gravity incline;" down which the cars will descend 1,000 feet to the mill. It is the intention to have all at work by November, 1888.

Joining the National on the east is the still more celebrated mine,

THE MINESOTA.

But the Minesota is of the past great; what it may become again is only conjectural. During a portion of its history, about thirty years ago, it was a very rich mine, one of the most remarkable mines ever discovered, and was a very profitable one. I have heretofore given, in former reports, a full history of the company and description of the mine. It is now owned by the same parties who own the National, and if the latter prospers, the work will be carried, probably, into the Minesota. These two mines are at Rockland, one of the most inviting localities in the upper peninsula.

For many years the Minesota yielded annually a small amount of copper to tributers. The aggregate of the mine's production is 17,352 tons, 668 fbs. D. L. Demmon, Sec. and Treas., Boston; Wm. E. Parnell, Su'pt, Rockland, Mich.

THE MASS MINE

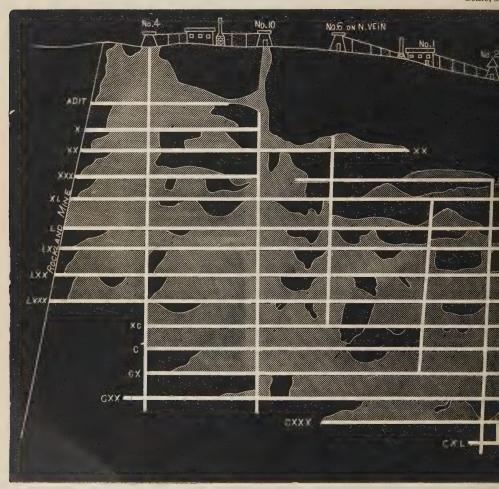
is worked now in a very small way by tributers. The Mass has proved to be a good mine, and has been very excellently well worked and managed; but it is too small. I still adhere to the plan set forth in my report of 1885, for combining the Mass and Knowlton mines, etc. At present there are 12 miners at work on tribute. Benj. F. Cheynoweth, Agent, Greenland, Mich.

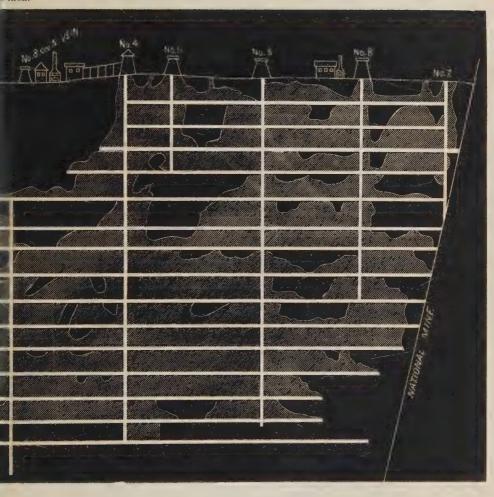
Table of product of Mass mine:

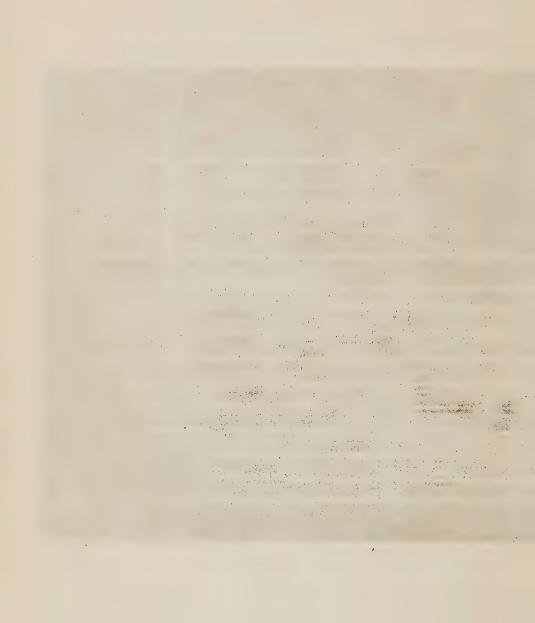


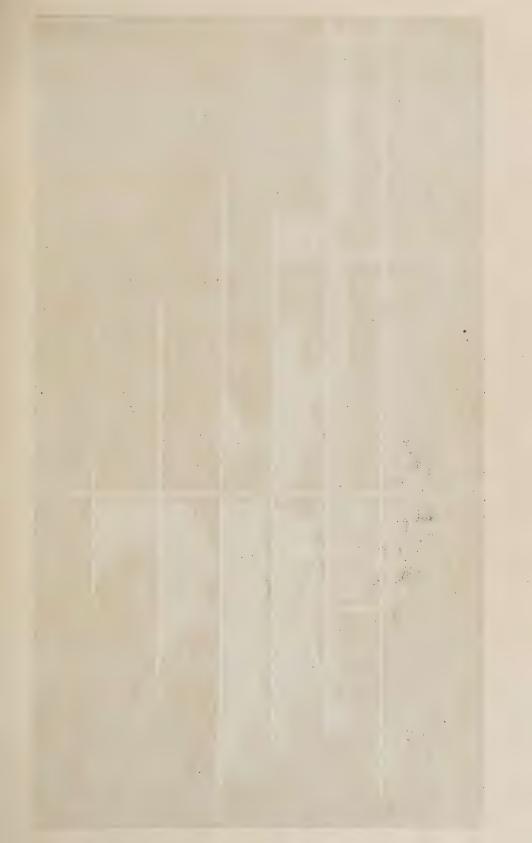
LONGITUDINAL SECTION

Scale, 3



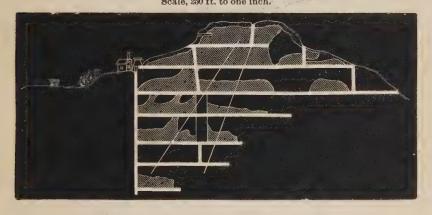






LONGITUDINAL SECTION OF THE EVERGREEN BLUFF MINE, 1888.

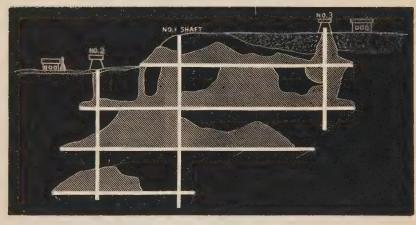
Scale, 250 ft. to one inch.

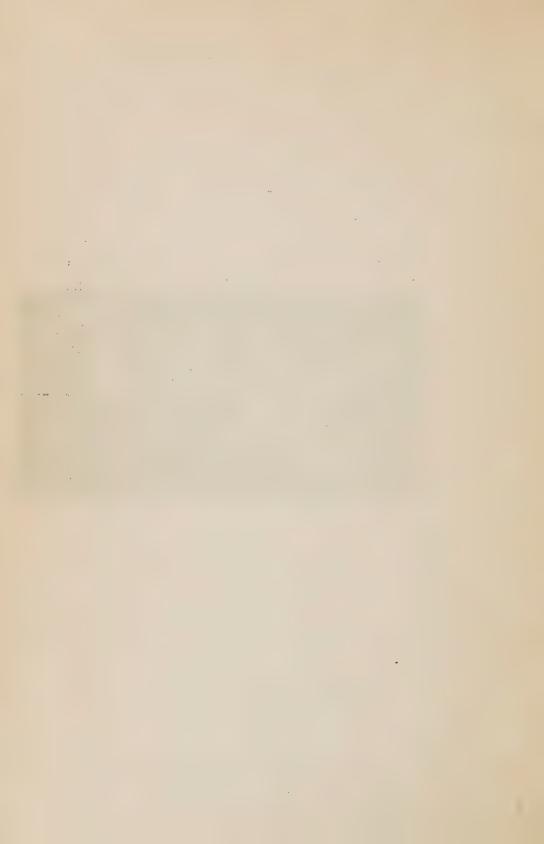




LONGITUDINAL SECTION OF THE KNOWLTON MINE, 1888.

Scale, 180 ft. to one inch.





Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1857	8	228	1878	4	265
1858	6		1874	5	1,925
1859	26	682	1875	1	1,014
1860	******		1876	40	1,952
1861			1877	54	238
1862			1878	206	339
1863			1879	228	294
1864	4	1,452	1880	258	1,159
1865	6	936	1881	233	1,684
1866	5	112	1882	368	1,446
1867	5	40	1883	329	1,474
1868	9	939	1884	281	718
1869	1	1,213	1885	181	1,500
1870	1	1,408	1886	123	1,179
1871	9	692	1887	8	
1872		1,403			
Total.				2,411	786

THE EVERGREEN BLUFF MINE

has been recently freed from water by tributers, who intend to explore it for copper. The mine is in the Evergreen Range joining the Ridge mine, and was once quite largely worked, from 1853 down to about 1870.

It has yielded, altogether, 678 tons, 1,870 fbs.

Rich'd Cheynoweth, lessee, Greenland, Mich.

THE KNOWLTON MINE

joins the Mass on the west or north, since the range runs here more nearly north and south than otherwise. The mine is idle still; it has yielded in all 323 tons, 1,993 tbs. The product obtained in 1887 was 19 tons, 870 tbs. There are no men working in the mine now.

F. W. Capon, Sec. and Treas., New York.

THE OGIMA MINE

joins the Mass on the south; 952 fbs. of copper were sent from the mine in 1887. It is also in Evergreen Bluff Range, as are the others above mentioned.

THE RIDGE MINE

is quite largely worked now for an Ontonagon mine. Preparations are making for an active year's work in 1888.

The mine has a good record, though it needs better machinery, a larger stamp mill, etc.

The following table shows the product for every year:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1855	30		1872	128	1,910
1856	35	631	1873	115	1,140
1857	36	1,874	1874	187	113
1858	29	790	1875	164	447
1859	39	690	1876	145	18
1860			1877	148	. 815
1861			1878	125	1,837
1862			1879	107	1,469
1863			1880	111	1,353
1864	8	917	1881	117	1.606
1865	85	433	1882	51	936
1866	71	411	1883	30	155
1867	94	1,537	1884	37	130
1868	86		1885	31	1,390
1869	126	1,840	1886	79	272
1870	122	1,700	1887	42	902
1871	175	150			
Total				2,570	1,066

Philip Highley, Treasurer, 60 Devonshire St., Boston, Mass.; Alfred Meads, Agent, Ontonagon, Mich.

The following report of the officers of the company give the facts of the working for the year:

RIDGE MINE REPORT FOR THE YEAR 1887.

The expenditures of the year have been:

Mine expenses	
Other expenses as per treasurer's account	\$10,434 62
From which deduct total receipts	8,789 49
Loss on the business of the year	\$1,645 13
•	======
The statement of assets and liabilities in last report showed a balance of \$15,145 93	
Deduct loss on business of 1887	
Balance on January 1, 1888	\$13,500 80
	,
BALANCE SHEET FROM THE BOOKS OF THE RIDGE COPPER COMPANY, JANUARY	2, 1888.
Receipts.	
Capital Stock—Paid in for property \$200,000 00	
Assessments	
Copper account—Sales to Jan. 1, 1887 \$1,024,550 12	\$419,938 50
Sales in 1887	
	\$1,033,339 61
Interest account—Collected to Jan. 1, 1887	16,635 92
Yield 76,095 per cent.	
Ingots	
	\$1,469,914 03
Expenditures.	
Real estate—Cost of property.	6909 541 00
Expenditures, as per published statement, to Jan. 1, 1887.	\$203,541 00 1,142,034 64
Mining account	_,_,_,
Smelting	
Expenses, taxes and copper charges 1,930 75	
Transportation 553 26	10,408 41
Dividend account—Paid Feb. 24, 1873	,
Paid Feb. 23, 1874 20,000 00	
Paid Feb. 8, 1874 20,000 00 Paid Feb. 10, 1880 9,784 50	
Take 100 10 to	59,784 50
Company's stock, costing.	304 40
Treasurer's account—Cash on hand	13,841 08
	\$1,469,914 03
STATEMENT OF LIABILITIES OF THE RIDGE COPPER COMPANY AND OF AVAILABLE A	ASSETS.
JANUARY 2, 1888.	2002204
Asse ts .	
Treasurer's account	\$13,841 08
Cash on hand at mine.	2 30
Supplies at mine	1,315 17
Liabilities.	\$15,158 55
Unpaid dividends	\$215 50
Drafts outstanding.	1,442 25 13,500 80
Balance	
	\$15,158 55
Balance of available assets over liabilities	\$13,500 80

RIDGE MINE, January 25, 1888.

Philip Highley, Esq., Secretary and Treasurer Ridge Copper Company:

Herewith I beg leave to submit a report of our operations at the mine for the year 1887. Tribute work has been continued through the year on a limited scale with satisfactory results, when we consider the small force employed and the limited amount of ground available in which tributers can work, for it must be remembered that this system of tributing has been carried on now for four years in ground many years ago abandoned as too poor to work, and confined almost entirely to the upper levels of the mine. The results, however, have shown different, and proven that the ground opened in the Ridge mine is capable of producing more copper per fathom of ground than any mine opened on the lake.

The production for the year has been 83 barrels of copper weighing 86,470 lbs, and 34 masses of copper weighing 25,236 lbs., a total of 111,706 lbs. Of this 106,448 lbs., or 55 tons and 853 lbs. Of this 106,468 lbs. were purchased of the tributers at $4\frac{1}{2}$ cents per lb., \$4,791.05, and 5,912 lbs., taken from the mine on company account, at a cost for labor, powder, fuse, etc., of \$100.

The total cost of the copper, including the labor, teaming, barrels, etc., was \$5,255.76, and all has been shipped to the smelting works at Detroit as heretofore.

The limited amount of ground now available for tributing, and the great demand for miners at remunerative wages in the iron mines in the south part of the county (just set off as the county of Gogebic) has caused such an exodus from the copper range as to amount to almost a desertion; for this reason all our houses are vacant (except two), causing quite a decrease in our revenue. All of the houses have been boarded up and taken care of, and all other property is being well watched and taken care of. As copper has ruled so low through the year (until the past few weeks), no development work of any consequence has been done, and my aim has been to keep all expenses down to the lowest point consistent with true economy in taking care of the property.

Underground in the mine everything is watched and kept in good condition; decaying timbers have been replaced by sound ones, falling and caving ground removed and supported by timbers, and all dangers or obstructions to the free drainage or access to the mine removed. The mine is unwatered to below the fifty fathom level, and as it can be kept there at small expense, it will be advisable to do so; for the purpose of keeping the mine open and making any repairs to keep the shafts and drifts in good condition.

It would seem that the price of copper has been permanently advanced to a point at which there can be no doubt the Ridge mine can be worked at a profit. I therefore renew my advice that the mine be equipped and worked for the production of copper at a reasonable outlay.

SUPPLEMENTARY REPORT.

Boston, Mass., February 28, 1888.

Philip Highley, Esq., Secretary and Treasurer:

DEAR SIR:—I beg leave to submit this supplementary report in order to give you facts, figures and estimates in reference to starting our stamp mill to work.

The mill has been idle many years and will require a general overhauling, and repairs; the trestle work approaches to the mill will require some new timbers and repairs, and the tram road from the mine to the mill will require new ties and a general over-

hauling; the hoisting engine, before it will be fit for continuous duty in hoisting the stamp rock from the mine, will require a general repairing as no repairs have been made on it for several years. The timber, logs, ties, cordwood, etc., should be got out at once before snow leaves the ground. If this is done the repairs to the machinery can be made in the spring so that we can be ready to start the mill by June 1. I estimate the cost of these necessary repairs at about §1,000.

I estimate that we have about 5,000 tons of good stamp rock in the mine broken by the tributers, ready for hoisting. The Ridge stamp rock has usually yielded 2 or $2\frac{1}{2}$ per cent., but as our rock has been more or less mixed with poorer rock by the tributers it may not be quite as clean, but I think it will run about $1\frac{1}{2}$ per cent. The 5,000 tons would yield us 150,000 lbs., or 75 tons of 80 per cent. mineral or 60 tons of ingot, which at 16 cents would realize us \$19,200. Should the percentage be 2 per cent. it would give us 100 tons of 80 per cent. mineral, or 80 tons of ingot, which at 16 cents would yield us \$25,600. If we place the cost of manipulating the rock at \$2, the highest figure, it would cost us \$10,000, leaving us a profit of \$9,200 if the percentage should be $1\frac{1}{2}$; and if it should be 2 per cent. it will leave us a profit of \$15,600.

The capacity of the mill is about 20 tons per day of 12 hours, or say 500 tons per month. A yield of $1\frac{1}{2}$ per cent. would give us a monthly yield of 15,000 lbs. of 80 per cent. mineral, or 12,000 lbs. of ingot, which at 16 cents would be \$1,920; deducting cost \$2 per ton, there would be a monthly profit of \$920. Should the percentage be 2 per cent. we would have 20,000 lbs. of 80 per cent. mineral, or 16,000 lbs of ingot at 16 cents, or \$2,550; deducting cost would leave us a monthly profit of \$1,560.

If preparations are made at once we could commence stamping by June 1; we would be able to ship in the fall the products of the months of June, July, August, September and October, and our treasury be replenished five times \$920 or \$4,600; or five times \$1,560=\$7,800.

I think all these estimates and figures can be verified by actual work; should the result of work prove as anticipated the mill could be worked night and day and stamp this season the accumulated sock with correspondingly increased results.

I estimate that our tributers have about 12 or 13 tons of copper, and as some of them are now working in rich ground we may reasonably hope to have about 18 or 20 tons of copper ready for shipment on the opening of navigation.

Very respectfully,

ALFRED MEADS, Superintendent.

THE RIDGE MINE.

At the annual meeting lately held, it was determined to call a special meeting on the 16th of April to authorize an increase of capital from 20,000 to 50,000 shares, 10,000 of which are to remain in the treasury, and the balance to be offered share for share at the market prices on the 16th of April. The following shows the financial condition of the company:

Assets.

Cash on hand	\$13,814 08
Cash at mine	2 30
Supplies at mine	1,315 17

Liabilities.

Unpaid dividends	\$215 50
Drafts outstanding	1,442 25

1,657 75

In 1887 this mine produced 111,700 pounds of mineral, equal to 84,902 or 76 per cent. ingot. Mr. C. H. Andrews was elected President, and Mr. Philip Highley as Secretary and Treasurer.

THE ADVENTURE

is a well knwn mine, though it has not been much worked since the early days of mining in Ontonagon. It remains entirely idle. It lies south of the Ridge, being in the N. W. 4, Sec. 35, 51, 38. I have given a full description in the Com. Report, 1880.

A. Meads, Agent, Ontonagon, Mich.

THE HILTON

is also idle. It joins the Adventure on the south or east, being in the E. $\frac{1}{2}$, Sec. 36, 51, 38. It is owned by the same parties that own the Adventure, etc. William Stanaway & Son are now working the mine on tribute.

W. F. Mason, President; A. Meads, Agent, Ontonagon, Mich.

THE ASTEC

is the next east, but there is nothing new to be said of it, and the same is true of

THE BELT,

which remains without change. The property is in charge of Hon. James Mercer, resident trustee, and Capt. Trevarrou, who lives at the mine.

A full description will be found of this mine in former reports, particularly in the reports of 1882 and 1885.

THE NONESUCH MINE

has been entirely abandoned and the machinery removed.

There are many miles of the copper range between the Evergreen Bluff and Portage Lake yet to be more thoroughly explored in the future. It is probable that important mines may be found; but there are none that have been worked for many years, and none that ever received much attention throughout this portion of the range. The first active mine north of Ontonagon is

THE ATLANTIC,

which is one of the most remarkable mines in the state. Remarkable for the uniformity of the deposit, the economy of the management and the fact that notwithstanding the excessive leanness of the lode the company continues to prosper. Through a series of years it annually not only makes ends meet, financially, but unfailingly accumulates a surplus for distribution among its stockholders. In previous reports I have dwelt quite largely on this interesting mine, and having visited it recently and finding nothing new to chronicle, I do not deem it necessary to recapitulate what has so lately been written. I have marked the map up to date and that, with Capt. Tonkin's report, will give the important new facts about the mine.

ATLANTIC MINE REPORT, FOR THE YEAR 1887.

The directors present the following report of operations during the year 1887:

The production of mineral was 5,074,361 pounds, which yielded 71.77 per cent., or 3,641,865 pounds of refined copper. The shipments to market amounted to 4,021,726 pounds (including 379,861 pounds of the product of 1886), which realized an average price of 12.12 cents per pound.

The following is a summary of the year's business:

Production.			
3,641,865 Ds. copper, at about 12.34c			\$449,504 38 2,774 57
			\$ 452,278 95
Costs.			¥250,170 00
Working expenses at mine as per clerk's tables		\$302,660 59	
Freight			
Smelting	35,284 12		
Expenses	6,354 91		
Brokerage	2,013 48		
Insurance	1,486 49		
Storage	384 95		
		59,007 43	
			361,668 02
Showing a mining profit in 1887 of			\$90,610 93
hereafter			
after		2,512 60	
			9,744 89
Leaving a net gain for the year of			\$80,866 04
The surplus trom 1886, after payment of dividend, was			264,100 09

Making the net surplus, Dec. 31, 1887. \$344,966 13 as shown in detail in the annexed statement of assets and liabilities, and out of which a dividend of one dollar and fifty cents per share (\$60,000) was paid February 1, 1888.

In order to take advantage of the improved copper market, the copper produced after the close of navigation was brought to market by rail and disposed of at satisfactory prices. We are thus enabled to close the copper account for the year, the net result being better than was estimated at the time of declaring the dividend. The surplus carried over will enable us to make some additions to the machinery that will be needed in order to maintain, without interruption, the present scale of production, which should give us about 4,000,000 pounds of ingot during the current year.

For details of the work performed, and its cost, we refer to the subjoined tables and summary of results. The usual financial statements and report of agent at the mine are also submitted.

JOSEPH E. GAY,
JOHN STANTON,
EDWIN H. MEAD,
ISAAC B. CRANE,
JOHN R. STANTON,
Directors.

NEW YORK, March 8, 1888.

ASSETS AND LIABILITIES, ATLANTIC MINING COMPANY, DECEMBER 31, 1887.

Assets.

Cash		\$21,907	33
Accounts receivable		25,195	08
Loans		40,000	00
Copper on hand sold		200,183	
		\$287,285	88
At Mine.			
Cash	\$3,197 03		
Coal	9,355 50		
Wood	14,061 90		
Supplies	26,550 59		
Merchandise in store	41,146 15		
		94,311	17
Total assets		\$381,597	05
Liabilities.			
Indebtedness at mine	\$18,753 43		
Agents drafts outstanding	5,903 38		
Accounts payable	11,974 11		
		36,630	92
Balance of assets		4011.000	10
Less dividend payable February 1st, 1888, \$60,000).	*******	\$344,966	10

SUMMARY OF RECEIPTS AND EXPENDITURES OF ATLANTIC MINING COMPANY, FROM DATE OF ORGANIZATION TO DECEMBER 31, 1887.

Receipts.		
Capital stock paid by consolidation	\$700,000 00 280,000 00	\$980,000 00
Sales of copper		5,669,094 82
Other sources		853 15
$\it Expenditures.$		\$6,649,947 97
Real estate ("South Pewabic" and "Adams" mines, buildings, railroad,		
stamps, etc., as valued at consolidation)	\$659,642 11	
Real estate (lands since purchased)	23,464 41	
•	\$683,106 52	
Net expenditure for additional equipment, mining operations, smelting; and	,	
marketing copper, taxes and incidentals	,261,875 32	8° 044 001 04
		\$5,944,981 84
Balance of receipts, being net profit to date		\$704,966 13
Deduct dividends paid		360,000 00
Net surplus December 31, 1887		\$344,966 13
(As shown in detail in the preceding statement).		
STATEMENT OF WORKING EXPENSES AT THE ATLANTIC MINE FOR THE DECEMBER 31, 1887.	YEAR E	VDING
Underground Expenses.		
Sinking 92.7 feet, average \$24.19 net	\$2,242 50	
Drifting 4,138.9 feet, average \$4.54 net	18,788 31	
Stoping 14,941.133 fathoms, average \$4.59 net	65,590 18	
Timbering, tramming and labor	59,300 03 7,501 47	
Timber, materials and supplies. Pumping and operating air compressors:	1,001 41	
Labor		
Fuel		
Supplies and materials 3,789 51	100 501 51	
Surface Expenses.	22,521 51	\$175,944 00
Superintendence, and labor of all kinds, less sundry credit items	\$25,666 89	
Supplies and materials	5,836 63	
Fuel	12,990 60	
Feed for teams, etc.	1,021 66	
Fire insurance	380 00	
Taxes	4,378 17	
Canal tolls on copper	369 94 747 32	
Expenses and sundry repairs		
T	\$51,391 21 4,235 00	
Less amount received for rents.	4,400 00	47,156 21
Railroad Expenses.	AW 6	
Labor	\$5,999 01	
Fuel	1,420 47 2,289 12	
Supplies.		9,703 60
Stamp Mill Expenses.	\$ 26,501 50	
Labor	29,635 56	
Supplies	11,536 74	
21		

Fire insurance	\$862 50	
Taxes	743 36	
Teaming, mineral, etc	572 12	
		69,851 78
Total running expenses		\$302,660 59
Construction Account—At Mine.		
Materials used in building and equipping trestle from No. 1 to No. 2 shaft,		
also additional trestle from No. 3 to No. 4, addition to No. 1 shaft house, en-		
house and hoisting machinery	\$4,066 49	
Labor on same	2,746 68	
Log dwelling	200 00	
At Mill.		
Log dwelling, etc.	219 72	
bog a wenning, evolutions of the state of th	210 12	7,232 89
Total expenditure		\$309,893 48
		4000,000 10
Summary of Results.		
Ground broken in openings and stopes	15,552.5 cub	oic fathoms
Rock stamped	255,750 tons.	
Product of mineral 5	,074,361 lbs.	
Product of refined copper 3	,641,8651bs.	
Yield of refined copper per cubic fathom of ground broken	234 lbs.	
Yield of rock treated, 14.24 lbs. copper per ton, or	.712 per cent	
Gross value of product, per ton of rock treated		\$1.7576
Cost per ton of mining, selecting and breaking, and all surface expenses,	including	
taxes		.8723
Cost per ton of transportation to mill		.0380
Cost per ton of stamping and separating.		.2731
Cost per ton of running expenses at mine		1,1834
Cost per ton of freight, smelting and marketing product, including New !	York office	.2307
expenses		
Cost per ton of working expenses		1.4141
Total expenditure per ton of rock treated		1,4522
Net profit per ton of rock treated (exclusive of interest earned)		.3053

AGENT'S REPORT.

ATLANTIC MINE, L. S., MICH., January 1, 1888.

John Stanton, Esq., Treasurer Atlantic Mining Co., New York:

DEAR SIR: - I herewith present the following report of operations at the Atlantic mine for the year 1887:

No. 1 shaft has been opened and put into working condition to the 5th level. On the 16th of August we began hoisting rock. Very fair rock has been taken from the 2d and 5th levels north and south of this shaft.

No. 2 shaft is down to the 11th level. We have drifted and stoped a considerable amount of rock from the following levels north of the shaft, viz.: 3d, 7th, 9th, 10th and 11th levels.

No. 3 shaft has been sunk from the 16th to the 17th level. The 14th, 15th, 16th and 17th levels have been extended north, and the 15th, 16th and 17th levels have been driven south of this shaft. Stoping has been done in all of these levels.

No. 4 shaft has been extended from the 14th to the 15th level. Drifting and stoping have been carried on in the 10th, 11th, 12th, 13th, 14th to the 15th levels south of this shaft. A large quantity of timber has been used to keep the mine in working condition, but notwithstanding this we have had some caves between the shafts and have had

to "spill" through some of the fallen rock, and with timbers form our levels sufficiently large to run the cars through the drifts and stopes beyond.

The drainage at the 16th level has made it necessary to use a small pump. A Gordon and Maxwell duplex pump has been located in this level at No. 3 shaft, and is operated by compressed air. It lifts the water to the 11th level, and the main pump takes it from this point to the surface.

The mine has never looked better than at present, and everything is in good working condition.

SURFACE.

A considerable amount of new work—necessitated by the opening of No. 1 shaft—has been done. A trestle road, 800 feet long, averaging 23 feet high, has been erected from No. 1 to No. 2 shafts and laid with 30-lb T rails. An additional trestle road has been constructed from No. 3 to No. 4 shaft, about 600 feet long and 35 feet high. This road has also been laid with 30-lb rails.

No. 1 shaft house was built in 1873. Some years thereafter the dump and sheaves were removed, and the building fitted for use as a merchandise warehouse. A great deal of work was therefore necessary to refit it for hoisting. The dumps and sheaves were rebuilt and replaced, and the building put in good working order.

An 18x24 "Bird" engine, with boiler, formerly used to operate the saw-mill, was repaired and refitted with drums and counterweight, and located for hoisting purposes at No. 1 shaft. It is enclosed in a building 30x40 feet. The hoist operates very economically, as the counterweight balances the skip, and the force is expended only in hoisting rock.

We have on hand a 16x24 "Bird" engine, with boiler, having ample power to operate the saw-mill, and will soon put it in place.

Many dwellings have received considerable repairs, several new roofs laid and six additions built. A warehouse, 80 by 35 feet and two stories high, has been erected for storage purposes.

The rock-breaking machinery, hoisting plants, pumping and compressing machinery are all in fair condition.

RAILROAD.

The road is in very good condition. A quantity of new 60-lb. steel rails have been laid, and a large number of new ties.

The rolling stock is in very fair condition.

STAMPING.

About the only changes at the mill during the year were replacing two 16-inch cylinders by two 18-inch ones, and a new duplex Worthington condenser. The larger cylinders have increased the capacity of the mill and enabled it to handle the increased quantity of the rock that has been sent to mill in the past three months.

The results per ton of rock are not so favorable as last year, the increased cost being largely due to the increase of 65 cents per ton in the cost of coal.

Allow me to refer you to the tables made by Mr. Van Tassel, which show the cost in every department, and also to the map exhibiting the work done during the past year.

I would recommend to your favor the officers who have all worked faithfully for the best interests of the company.

Yours truly,

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1866	6	1,475	1887	1,027	304
1867		1,760	1878	1,132	1,592
1868	764	258	1879	1,152	1,822
1869	823	857	1880	1,170	1,195
1870	186	617	1881	1,264	9
1871			1882	1,315	1,708
1872			1883	1,341	197
1873	431	1,336	1884	1,586	1,585
1874	6 86	403	1885	1,791	588
1875	783	1,036	1886	1,751	1,670
1876	917	1,041	1887	1,820	1,865
Total				19,951	1,296

It will be seen that the product of 1887 was the largest in the history of the mine. The mine is no richer, only more rock was stamped. As a post-script to the foregoing, I may state that a few men are employed on Sec. 16 exploring by test pits. They encounter considerable depth of drift covering the ledge.

The company is preparing to make No. 1 a double skip shaft, that is to put in a second skip track; it is now to the 7th level; work in the 2d level in this shaft develops considerable "barrel work." At No. 2 shaft they have put in a balance car to the skip and have removed the hoisting engine at No. 2 to the foot wall side.

No. 3 shaft is sunk to the 18th level, and they are preparing to extend the skip track from the 17th down.

In No. 4 shaft the skip road has been carried down to the 16th level, from which point they are now hoisting—July, 1888.

The following table gives the important results of the Atlantic mine's operations for the past 13 years:

	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1889.	1883.	1884.	1885.	1886.	1887.
Number of tons of rock stamped	80,000	969,696	105,780	121,709	112,668	169,825	176,555	189,800	195,669	209,510	241,010	247,035	255,750
Yield of ingot per ton, in pounds	19.58	18.99	19.42	18.50	19.00	14.27	14.36	13.866	13.708	15.1	14.86	14.18	14.24
Number of fathoms broken in mine	5,628	6,550	7,091	8,299	8,665	9,929	9,240	10,170	11,163	12,210	13,403	14,724	15,552
Yield of ingot per fathom, pounds	27.8	280	290	243	266	244	2,735	259	240	259	267	238	234
Cost in cents per ton for stamping and washing	87.96	60.79	57.79	48.85	42.44	38.13	42.54	37.07	35.25	39.95	30.36	26.53	27.31
Total cost per ton of rock mined, etc	3.90	3.58	3.08	2.78	2.33	2.25	1.96	1.9082	1.7789	1.71	1.436	1.2801	1.4522
Total average cost per pound, ingot	\$0.2212	\$0.1895	\$0.1637	\$0.1683	\$0.1220	\$0.1584	\$0.1368	\$0.1376	\$0.1256	\$0.1087	\$0.938	\$0.908	\$0.1020
Average price per pound received for copper	.2247	.2135	.1854	.1615	.1630	1997.	.1712	.1756	.1500	.1181	.1116	.1092	.1212
Dividends paid			1 1 1 1 1	20,000	30,000	40,000	80,000	80,000	40,000	20,000	40,000	40,000	000,00
Net profit per ton of rock		.44	.51	1.01	18.	.5000	.4711	.4958	.2483	.0919	.2205	.1529	.2706
Per cent. of copper in rock	976.	676	176.	.925	.95	.713	.718	.693	.685	755	.743	.709	.712
				-									

THE HURON COPPER MINING CO.,

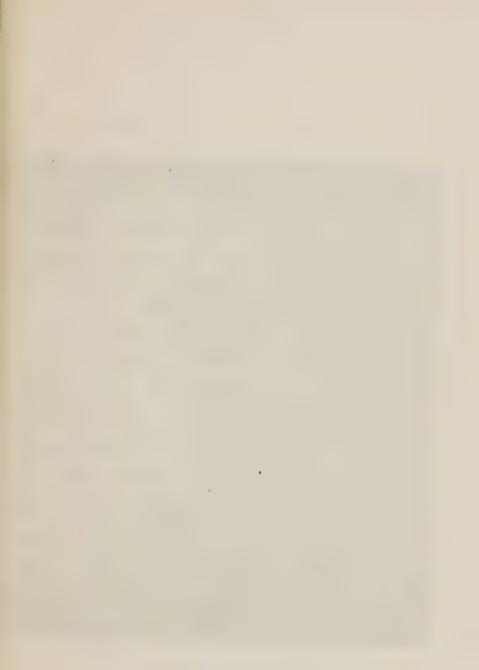
since its re-organization in 1880, has made a good record. The undertaking was bad enough to begin with, but added to the original difficulties, which were understood and could be provided for, there have been unforeseen troubles, serious accidents, which have increased the burden. Each year has brought with it some misfortune at the mine—dam giving away, explosion of boilers, and finally the destruction of the stamp mill by fire. Still the company, through persevering effort and most excellent management, has successfully breasted its era of troubles, and having kept its craft afloat through a period of adversity may now reasonably hope that the silver lining to the clouds which have obscured its horizon indicate the dawn of better days, and that under calmer skies and upon smoother seas the ship freighted with the Huron's fortunes is destined, perchance, to enter upon a prosperous voyage.

The stamp mill is better than before the fire, since there are several new boilers and the arrangement of the necessary buildings has been much improved. There are, as before the fire, two head of stamps, which work up 375 tons of rock per day. The stamp mill is first-class and is doing good work. The facilities for pumping the water have been increased and modified, and altogether the water supply rendered more abundant and secure. Capt. Vivian declares that the mine is better at greater depth, becoming more purely amygdaloid. The mine furnishes some excellent rock, and if extensively opened, a good deal of good rock can be had.

Capt. Vivian has been experimenting with the Jewel filter to purify the mine water for the boilers.

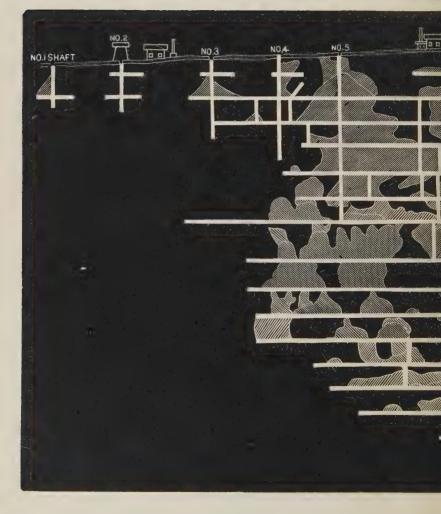
He states that filtering of the water is of great advantage to the boilers. I may add that they are using the Jewell filter—one of a capacity of 125,000 gallons per day—at the Hecla mine, and are so well pleased with the results as to have ordered one also for the Calumet mine. It is declared to effect a saving of fuel and to preserve the boilers. I have marked up the map to the close of the year.

Table of product of Huron mine:



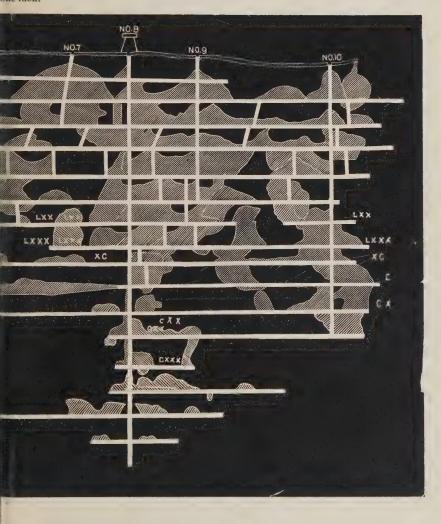
LONGITUDINAL SECTION

Scale,



E HURON MINE, JAN., 1888.

one inch.





Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1855	3	~~~~	1872	276	1,684
1856	12		1873	237	1,883
1857	35		1874	^ 125	1,005
1858	24		1875	31	1,289
1859	22	1,387	1876	31	1,857
1860	4	1,000	1877	41	161
1861	49		1878	32	1,100
1862	69	1,305	1879	14	1,760
1863	69	206	1880	35	285
1864	50	1,745	1881	127	. 515
1865	238	11	1882	182	579
1866			1883	360	213
1867	683	1,164	1884	963	1,660
1868	740	80	1885	1,135	1,163
1869	841	863	1886	996	995
1870	42	183	1887	742	103
1871	134	1,453			
Total			***************************************	8,354	1,659

D. L. Demmon, Secretary and Treasurer, 19 Congress street, Boston, Mass.; Johnson Vivian, Superintendent, Hancock, Mich.; T. Whittle, Mining Captain; Alex. Loranger, Clerk.

The Huron is the most southerly of a group of mines situated south of Portage Lake in the village of Houghton and opened in the Isle Royal lode. Its experience is of value to the companies north of it, between it and the lake.

I witnessed at the Huron in December an interesting trial of the Gates rock crusher. It works very rapidly and effectively; 12 tons of rock were run through the machine in 14 minutes. Three men worked incessantly to supply the machine, and two others to keep it clear, which they were so far unable to do that a stoppage of two minutes was required. The test thus indicated that the machine would crush one ton per minute. The larger, No. 6 machine, would probably do much more than this. There is no question of the effectiveness of these machines. They will do more work and do it better than any other breaker I have ever seen tried. The trouble is, if any, they do too much; rock can not be had to supply them. A ton per minute is too much rock for one mine to supply. It occurred to me that the rock was put into better shape for the stamp than it is done by the ordinary breaker.

THE ISLE ROYAL MINE

joins the Huron on the north. The mine has not been worked for many years. All of the south side mines were failures, including the Atlantic, when formerly worked by a prior company under the name of the South Pewabic, and it would be a failure to-day if it were worked as it then was. Low grade copper bearing belts can not be worked at a profit on a small scale. There must be vigorous, intelligent management, and all the modern appliances of mining, to make mines in such a deposit as the Isle Royal profitable.

A large quantity of rock must be mined and manipulated, and with the use of compressed air drills, high explosives, large hoisting skips and winding drums, powerful engines, the improved Ball stamps and Collum washers, etc., etc., this has become an easy matter.

Two of the old mines in the Isle Royal lode, one on either side of the mine of that name, have been re-opened and worked since the former abandonment. The Huron on the south, and the Grande Portage on the north, and both afford evidence that the belt is a paying one to work if worked rightly.

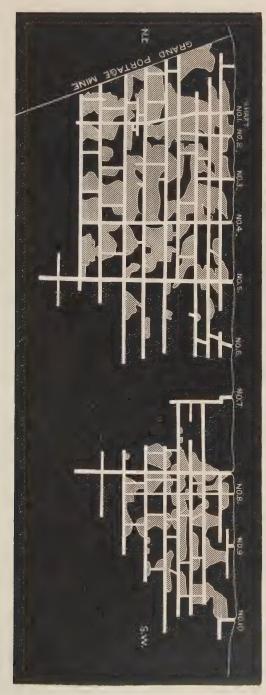
No fact is better established by the experience of copper mining on Lake Superior than this, that all things being equal, the greater the output, the better the chances for a favorable result. Like all amygdaloids the Isle Royal lode is bunchy, wide and narrow, rich and poor in places, it must be so opened and worked as to leave the poor ground standing and take out the good rock. There is an effort making to combine

THE ISLE ROYAL AND GRANDE PORTAGE AND SHELDON COLUMBIAN MINES

under one corporation, and I certainly esteem the project a good one. Equipped and worked as the Osceola and Atlantic are equipped and operated, and it would be as profitable. The properties combined could be economically worked. They are favorably situated. A long adit from near the lake, driven south in the lode, would prove the mine and give several hundred feet of "back" through a long distance, upwards of a mile to the Huron line. The old shafts would afford ventilation. The adit would secure drainage and would constitute an avenue for sending out the rock from the mine. There are two, possibly more, well defined copper bearing belts on these properties. Both have been mined in and have shown to be about equally rich. The maps herewith given show that the good and poor ground are about the same in each of the Portage mines. The dark portions represent the standing ground. The vein makes mass and barrel copper, and some fine stamp copper rock of which the prevailing mineral is epidote. The hanging walls are good, being firm trap rock.

LONGITUDINAL SECTION OF THE ISLE ROYAL MINE, 1888.

Scale, 300 ft. to one inch.





The Isle Royal and Huron were both early mines. Comparing their products from 1855 to 1882, it seems that the former produced the most copper, 422 tons more than the Huron in that period. It was no more extensively worked than the Huron, was no better fitted out with machinery, so that it is safe to conclude that the Isle Royal has equally as rich a portion of the lode as the Huron.

Provide machinery and work them largely, and I see no reason why they should not pan out as well as the Franklin and Atlantic.

The Isle Royal mine has produced in toto, 4,602 tons, 71 lbs. refined copper. The estate consists of 480 acres, lying in the village of Houghton. Graham Pope, Agt., Houghton, Mich.

THE GRANDE PORTAGE MINE,

lying contiguous with the Isle Royal, has been fully described in former reports, particularly in that of 1882. Also what I have herewith said of the Isle Royal mainly, also includes the Grande Portage. If the two mines are combined and operated as one by a single company; and better still, if the combination includes the Sheldon-Columbian, it will certainly, in a mining sense, be a wise move.

The Grande Portage has been idle for four years past.

The mine has produced in all 1,613 tons, 434 lbs. of refined copper.

Peter Ruppe, Sec. and Treas., Hancock, Mich.

THE SHELDON-COLUMBIAN MINE

lies between the Grande Portage, and the margin of Portage Lake. It has not been operated for many years, and if again opened up as a mine it will be, probably, as one of the combination previously alluded to in describing the Grande Portage, etc. The mine produced during the years that it worked 708 tons, 548 fbs.

Graham Pope, Agt., Houghton, Mich.

THE QUINCY MINING COMPANY.

The Quincy mine that has heretofore stood second in the rank of copper producers in this State, is now relegated to the third place, not through any falling off in its own product, for the mine is as rich and productive as ever, but through the fact that the Tamarack has superseded it; has become a larger producer.

The Quincy, however, heads the list of amygdaloid mines; and there is no likelihood of its losing this place. The Quincy has very rich ground; not

all of it, perhaps, but the greater portion of the amygdaloid is well mineralized. It is a wide belt, and some of the best ground is found in the "pockets," or branches lying east and west from the main lode.

The ground plan of the levels looks like the projections of an iron mine, so irregular. The Quincy has been uniformly good for many years. The company has been relieved from anxiety as to its product. The mine has been so uniform in quantity and quality of rock, one year and another that, without change of plant or increase of force or effort, the product each year varies but little. This is shown by the percentage of copper obtained, as given in the following table:

Year.	Per Cent.	Year.	Per Cent.	Year.	Per Cent
1861	2.55	1870	2.61	1879	1.8
1862	2.03	1871	2.29	1880	2.5
1863	2.75	1872	2.17	1881	2.8
1864	2.96	1873	2.60	1882	2.8
1865	2.60	1874	2.61	1883	2.8
1866	2.63	1875	2.44	1884	
1867	2.74	1876	2.38	1885	2.7
1868	2,25	1877	2.11	1886	2.7
1869	2.48	1878	1.76	1887	2.9

This table shows that there is no deterioration in the quality of the rock. It gave a larger percentage last year than ever.

The burning of the rock house at the mine was no loss to the company in the long run. It has a much better one now and in a much better situation than the one destroyed. In fact the new rock house is admirable, and the situation is such as to meet future requirements of the mine. The manengine machinery has been altered to great advantage too. There are not many changes about the Quincy; it is an old mine and was equipped years ago. Some things are old-fashioned and would be better if more modern, perhaps.

I notice judicious modifications from time to time, as I frequently visit the mine. Capt. Harris is alive to improvements and is constantly making them to advantage.

The mine has reached a depth of 2,800 feet, to the 37th level, and is thus one of the deepest mines on the lake. A fuller description of the mine would necessarily involve a repetition of what has been said in previous reports. I have discussed in previous reports, particularly in that of 1881, the Quincy stamp mill. There is no doubt but the company has needed a more

\$736,509 75

modern mill for years. It has cost too much to manipulate the rock. Comparative results with the Osceola, Atlantic mills, etc., tell the story. The company has decided to construct an entirely new mill on Torch lake, where it owns a mile in length of land bordering the lake, in Sec. 23, 55, 33. The mill will be in lot 3, about a mile south of the Osceola and Tamarack stamp works. The company owns on both sides of the lake, which is here about half a mile wide.

The average depth of the water at this point is said to be 61 feet. The company will build a railroad from the mine to the mill. The organization for this purpose is called the Quincy and Torch Lake Railroad Co.

The commerce of Portage lake, and particularly of that portion of it between Hancock and Houghton, is of so much importance that the vast amount of sand run into the lake by the stamp mills located there is a serious matter, and the U. S. Government officers have from time to time intimated to the copper companies that such disposal of their refuse must finally cease. The filling up of the south end of Torch lake is a matter of minor importance.

The survey for the railroad has been made and the distance found to be six miles, with a maximum grade of 80 feet.

The following report by the officers of the company gives the main facts of the year's work.

QUINCY MINE REPORT.

Annual Report of the Directors of the Quincy Mine for the Year 1887.

Agent's Report.

The directors submit the following report of the business of the mine for the past year, and statement of the financial condition of the company:

The product of the mine as prepared for shipment was 6,743,510 pounds, or 3,371 1810-2000 tons of mineral, yielding about 83 18-100 per cent., or 5,609,762 pounds of refined cop-	### 0 000 A4
per, for which has been realized the gross sum of	\$658,382 94 3,772 12
	\$662,155 06
The expenses of the year are as follows: Running expenses at mine	
Building, construction, and real estate account 75,586 73	
Smelting, transportation and all other expenses	486,464 19
Leaving as mining profit	\$177,690 87 10,037 42
Making the income of the year The statement of assets and liabilities in our last report showed a balance	\$187,728 29 on hand,
as of date,	
January 1, 1887	\$548,781 46
Add earnings of 1887	187,728 29

a 1/V	
Deduct dividend of Feb. 15, 1887	00
Deduct dividend of Aug. 25, 1887 40,0	00 200,000 00
Leaving balance of assets, Jan. 1,1888	
A dividend of \$4.00 per share, or \$160,000 payable February 15, has been	
which, with dividend of \$1.00 per share, paid August 25 last, makes t	
year \$200,000.	201 0220
The usual financial statements are submitted, and also the report of the a	cent which
states clearly the present condition of our property.	gone, winon
THOMAS F. MASON,	Prosident
New York, February 20, 1888.	1 100000100
New Tork, repluary 20, 1000.	
GENERAL SUMMARY OF RECEIPTS AND EXPENDITURES OF THE QUINCY MINING CO	MPANY, FROM
ITS ORGANIZATION TO DECEMBER 31, 1887.	
Receipts.	
From capital stock paid in	
From proceeds copper and silver (93,853,639 lbs. copper)	
From profit on sale P. L. & R. Improvement Company stock, and other investments.	
From sale of real estate, Hancock	
FIVE SULV OF TOWN OUTGOOD AND OUTGOING	\$18,648,140 46
By balance brought down, being receipts over expenditures	
Deduct dividends declared, Nos. 1 to 38 inclusive	
Leaving balance as per statement in detail below	\$536,509 75
Expenditures.	
For expenditure on location previous to 1856.	
For expenditure on Quincy vein, 1851, not now worked	
For openings and explorations on 3,800 feet "east," or Pewabic vein, extending to Porage Lake, preparatory to future work.	
For real estate and permanent improvements on same, including dwelling houses, stan	,
mill, machinery, steam engines, tram roads, dock, warehouses, and other buildin	
and roads	
For mining and surface labor, expenses of smelting and marketing copper, and alling	
dental expenses	, ,
DOLLING WOTH	\$18,648,140 46
	\$10,010,140 40
STATEMENT OF ASSETS AND LIABILITIES, EXCLUSIVE OF REAL ESTATE, MINE PLAT	AND SUPPLIES
in Use, January 1, 1888.	
Assets.	BONK 000 00
Loans on call	,
Cash on hand at mine	,
Copper on hand, sold.	
Accounts receivable	
	\$538,713 2
Liabilities,	
Drafts unpaid \$40,477	
Dividends unpaid	50

Accounts payable in New York.....

" at mine....

11,875 00

20,842 34

\$73,895 08 \$464,818 16

Add at mine, viz:	
Supplies per inventory on file \$63,088 50	
Farm account (horses, wagons, etc.) 8,574 49	
Accounts receivable 28 60	
	\$ 71,691 59
Less dividend payable February 15, 1888, \$4.00 per share, \$160,000.	\$536,509 75
Summary for the Year.	
Average force employed	447 men
" number of miners	142 ''
wages of miners on contract per month	
Yield of mineral per fm. of ground broken	976 lbs.
" of refined copper per fathom of ground broken	781 "
Total rock mined	124,289 tons
" hoisted	96,370 "
" stamp rock treated	94,250 "
Yield of rock stamped, mineral 3.2	3 per cent.
Product stamp mineral 6,092,475 lbs	
" masses 651,035 "	6,743,510 lbs
" refined copper	5,609,762 lbs

AGENT'S REPORT.

QUINCY MINE, HANCOCK., MICH., January 31, 1888.

The following report of our operations at the mine for the past year is respectfully submitted.

The general appearance and productiveness of the vein, in both the north and south portions of the mine, continued favorable throughout the year.

No. 2 shaft was sunk from the thirty-fifth to the thirty-seventh level. This shaft is still several feet west of the main copper-bearing part of the vein belt, but during the last one hundred feet in sinking it passed through several bunches of vein matter carrying good stamp rock,

The drifting done from this shaft was at the thirty-seventh, thirty-sixth and thirty-fifth levels north. The thirty-seventh level was drifted a few feet south of shaft, and the thirty-sixth level was connected south with the drift from No. 4 shaft. Those openings showed a good average of productive vein, characterized by stretches of lean ground, low-quality vein, and blocks more or less rich in the different grades of copper.

The principal stoping done in this part of the mine was at different points at and between the thirtieth, thirty-first, thirty-second, thirty-fourth and thirty-fifth levels north, and in a rich block of ground at the thirty-third level south of shaft. Considerable good stoping ground is still available here and there between the twenty-eighth and thirty-fifth levels north and south of both shafts; while at and below the thirty-sixth level but little stoping at all has been done either at No. 2 or No. 4 shaft.

No. 4 shaft was sunk from fifty feet below the thirty-fifth level to the thirty-seventh level. This shaft is also a little west of the main copper-bearing part of the lode, but showed, in sinking, occasional patches of good stamp rock.

The drifting done from this shaft was at the thirty-seventh level north, and thirty-sixth level north and south, and at the thirty-fifth, thirty-fourth, thirty-third and thirtieth levels south. Most of the vein exposed in the thirty-sixth and thirty-fifth levels is very promising. The vein shown in the thirty-fourth and thirty-third levels is more of the mine was at and between the thirty-second, thirty-third, thirty-fourth and thirty-fifth levels north and south of shaft.

The man-engine shaft was extended and put in working order from the twenty-ninth to the thirty-first level, and is now being sunk towards the thirty-third level.

The diamond drill was not used much in bunchy, having stretches of alternating good and poor ground.

The vein in the thirty-second and thirtieth levels, while showing occasional bunches of playing ground, is narrow and of much poorer quality than it is in the lower levels.

The principal stoping done in this part during the year. A few holes were bored a the twenty-fifth level north of No. 2 shaft, but nothing of value was discovered.

The accompanying maps, filled up as usual to the end of the year, show as near as may be the position and extent of work done in the various openings.

Several unavoidable accidents during the year caused more or less serious delay both at the mine and the mill. Those mishaps, however, were mostly overcome in good time, and eventually we shall profit by the improvements made by way of reconstruction.

On the night of June 7 the rock house and adjuncts, with nearly all machinery enclosed, were totally destroyed. The fire undoubtedly was caused by lightning, which struck the drum house at head of main "incline," and the whole range of buildings was soon a mass of flames, which it was impossible to extinguish.

Means were at once improvised, by erecting a temporary rock house, for handling the rock and sending it to mill, and regular ruuning operations were resumed as soon as possible.

On the 24th of August, the stamp mill was closed down for some time, on account of the breaking of both main engine shafts. This caused the stoppage of the mill for about four weeks; and the burning of the rock house, drum house, etc., necessitated a delay of about the same time, the total suspension of the stamp mill covered a period of nearly two months.

During the summer the water pipes which supplied the mine boilers from the lake out, but, fortunately, no serious breakage occurred, and a new line of six-inch castiron pipes, some forty-four hundred feet in length, was laid and put in use. As the old pump at the mill was becoming inadequate to this service, it was replaced by a new compound one—size 14-20x7x12—which makes this plant complete, and independent of the rest of the works, and sufficient for all probable contingencies.

The new rock house was ready for use about the middle of November. It stands several hundred feet north of the old one, being just opposite to No. 7 shaft. It is designed and equipped for doing the best possible service. Steam for operating it is taken from the main boilers at the mine.

For the transportation of rock a substantial trestle work was built for car tracks, over which the rock is sent from the shaft house to the rock house.

From the rock house to head of "incline" a second gravity road was built, and the old tram road was made new throughout, thus completing an entirely new outfit all the way from the stamp mill to No. 4 shaft,

The fire plant for the mine was finished early in the season, and proved to be of great value, for by its use the other mine buildings were saved at the time of the rock house fire.

At the mine boiler house an additional railroad trestle for side track was built, and the coal yards, both at the mine and the mill, were considerably enlarged so as to hold the needed supply of fuel.

A new dump scow for the removal of stamp sand has been built, and will be ready for use next season.

S. B. HARRIS, Agent.

Table showing yearly product of Quincy mine:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
856	6	1,462	1872	1,334	1,134
857	61	762	1873	1,400	
1858	153	. 772	1874	1,525	654
859	178	1,114	1875	1,334	281
1860	970	414	1876	1,536	1,171
1861	1,218	852	1877	1,427	336
1862	1,153	218	1878	1,480	449
1863	1,115	1,737	1879	1,323	1,458
1864	1,251	586	1880	1,848	268
1865	923	1,500	1881	2,753	884
1866	1,172	1,000	1882	2,832	1,796
1867	1,013	1,000	1883	3,006	239
1868	727	1,000	1884	2,825	436
1869	1,208	1,365	1885	2,924	497
1870	1,248	1,777	1886	2,961	1,529
1871	1,204	1,501	1887	2,804	1,76
Total			,	46,863	1,81

THE FRANKLIN MINING CO.

The Franklin mine was once, as now, in a prosperous condition, but this earlier period of good fortune was succeeded by many years of adversity. By being leased on tribute the affairs of the company and the condition of the mine reached a pretty low ebb. It has been brought up again by good management, vigorous, intelligent, economical management. It is the Pewabic lode, but is not in rich ground like the Quincy, but just about rich enough to work at a profit when operated as it is now.

The map herewith given does not show the underground extensions of work for several years past; but it is valuable as showing the situation of the Franklin, Pewabic and Quincy mines with one another, and also the location of the shafts, etc.

No. 2 shaft is now to the 29th level and can not be further sunk; it is still used, however, as there is stoping ground reached from the shaft in nearly all the levels below the 16th. No. 3 shaft is to the 30th level and the stoping is mainly below the 24th. No. 5 shaft is sunk to the 29th level. Not much

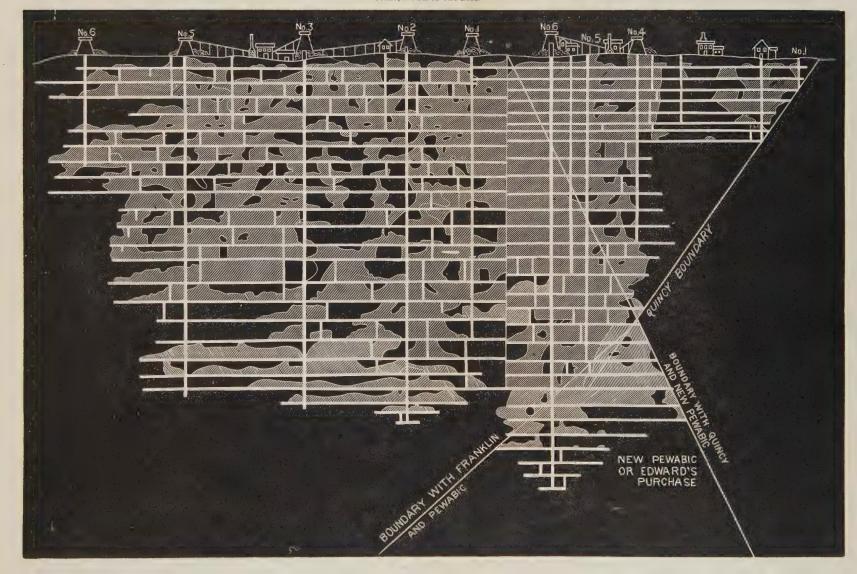
timber is required in the mine; the hanging wall stands well. The vein is "bunchy," but unlike the Quincy, has not afforded the side branches that have been so important in that mine; recently some discovery of this sort has been made with the diamond drill, an amygdaloid pocket east of the main lode has been found, which it is reported, is rich in copper.

I have copied from the company's books fuller details of the work than are given in the printed report:

Company Account—Labor, and Cost of Same.	
Number men	128
Mining captains, timbermen	\$12,823 00
Miners' account, day account	1,027 13
Engineers, firemen, machinists	12,456 38
Trammers, laborers	34,282 35
Total	\$64,060 05
Number men	8.
Shafts	440
Winzes	
Average cost per foot	16 84
Total cost sinking shafts	7,412 65
Mining Expense—Drifting, Cross-Cutting.	
Number men	25
Number feet drifted	2,634.7
Average price per foot	\$9 78
Total cost	\$25,778 98
10ta1 cost	\$60,110 90
Statement of Stoping.	
Number men	98
By air drill, number fathoms	9,496.5
Average price per fathom	\$10 24
Total	\$97,048 85
Mining expense, sundry labor.	9,607 76
Cost of Supplies and Fuel.	
Supplies	\$12,798 08
Wood, coal and teaming	28,536 15
Total	\$41,334 23
Less profit on miners' supplies	17,914 25
Total	\$23,419 98
Recapitulation of Mining Expenses.	****
Company account, labor.	\$64,060 05
Sinking shafts and winzes.	7,412 65
Drifting and cross-cutting.	25,778 98
Stoping.	87,048 85
Sundry labor	9,607 78
Supplies, fuel.	23,419 98
Total	\$217,328 27
Number of men on company account	128
Number of men on contract	126
Total number men	254
Tons of rock hoisted	173,874
Total rock rejected	36,737

LONGITUDINAL SECTION OF THE FRANKLIN AND PEWABIC MINES, JAN. 1888.

Scale, 420 ft. to one inch.





Tons to mill	137,137
Per cent. rejected	/ 21
Sunk No. 2 shaft 9 feet; No. 3 sunk 233 feet; No. 4 sunk 440 feet.	
Total number feet drifted 2,634.7; number fathoms stoped 9,496.927.	
Surface Expenses. Number men	341%
Wages	\$16,069 81
Teaming	4,195 67
Wagons and sleighs and other repairs	572 78
Total	
Less house rent and charges.	\$20,838 26 9,006 07
Net total	\$11,832 19
Stamp Mill Expenses.	***
Number men.	56
Number cords wood.	10,495
Cost foundry bills	\$28,128 51 3,225 46
Cost, other supplies.	4,104 69
Cost of labor	22,006 32
Total	
	\$57,569 98
Results of Stamping.	22
Number days average per man running	
Per cent. per ton.	137,137
Pounds of copper	3,321,985
Tons stamped per cord of wood, average	13.06
Cost per ton of rock stoping	\$41.98
Tram Road Expenses.	
Number men	14
Cost of labor	\$6,713 26
Cost of supplies	1,708 91
Total cost	\$8,422 17
Number tons of rock run over to mill.	137,137
Cost per ton	\$6 14
Rock House Expenses.	
Number men	37
Cost of labor	\$14,756 25
Cost of supplies	529 89
Total cost	\$15,286 14
Tons of rock	137,137
Cost per ton	\$11 14
Cost hauling per ton rock hoisted	8 78
General expenses—Insurance, taxes, agents, etc.,	10,363 32
Office expenses-Showing cost of office clerks and sundry items, total	2,519 41
Construction	1,791 23
Summary of Expenses.	200
Number of men.	399
Mining expenses	\$217,328 27
Surface expenses	11,832 91 57,564 98
Tram road expenses.	8,422 17
Rock house expenses.	15,286 14
General expenses	10,363 32
Office expenses	2,519 41
Construction, general repairs expenses.	1,791 25
	\$325,107 71
Total expenses	Annotant 17

Rock Account.

Rock on hand January 1, 1887	27,518	tone
	165,246	
Mined during year	100,240	tons.
Total rock	192,764	tons.
Hoisted during 1887	173,874	tons.
Rock on hand January 1, 1888	18,890	tons.
Pounds of mineral per fathom of rock hoisted		494
6. 66 ingot 66 66 66 66		405
" " mineral " ton " " "		27.47
" ingot " " " " " " " " " " " " " " " " " " "		22.52
" "mineral " " stamped		34.83
" ingot " " " " "		28.55
Per cent. of mineral in rock stamped		1.74
" " ingot " "		1.42
" " mineral" " hoisted		1.27
" " ingot " " ' "		1.12
Cost of mineral per pound at smelting works		\$ 6 86
" "ingot " " " "	1	8 30

Lands owned by Franklin Mining Co. N. $\frac{1}{2}$ Sec. 14, S. W. $\frac{1}{4}$, Sec. 15, S. E. $\frac{1}{4}$, Sec. 15, all in T. 55. N., R. 33 W; and N. E. $\frac{1}{4}$ and W. $\frac{1}{2}$, Sec. 11, T. 55. N., R. 34 W., and W. $\frac{1}{2}$, S. 24, T. 55, R. 34; S. W. $\frac{1}{4}$, S. 36, T. 56, R. 34, W. $\frac{1}{2}$, S. E. $\frac{1}{4}$, S. 25, T. 5, 6 N., R. 34 W.

The present company has produced from July 1, 1874, to Jan'y 1, 1888, $13\frac{1}{2}$ years, 39,148,464 lbs. of copper; and from 1857 to 1870, $12\frac{1}{2}$ years, the old company produced 14,565,723 lbs. By tribute work, 1870 to 1874, 4 years, 2,206,774, making a total of 55,920,959.

FRANKLIN MINE REPORT.

BOSTON, March, 1888.

To the Stockholders of the Franklin Mining Co.:

Annexed you will find the usual statement of the doings and affairs of your company for the year ending December 31, 1887. The statements of assets and liabilities, showing a balance of assets at that time of \$259,988.00, from which a dividend of one dollar per share (forty thousand dollars) was paid January 2, 1888, leaving us, after paying that sum, a larger surplus than we had at close of business December 31, 1886. We also hand you the report of our agent of the doings at the mine for the year, its present condition and future prospects, which, with copper at present price, certainly promises well for a successful business the coming season.

Our buildings, machinery, etc., are in good condition, and we have added during the year a hoisting engine, which will materially facilitate our business, the cost of which has gone into general expenses.

We have a large amount of rock in the mine, say 18,890 tons, broken and ready for hoisting, which we have not valued in our assets, the cost of breaking which has gone into our regular expense account.

As will be seen by our agent's report, the cost of producing rock per ton was \$1 87-100, a saving of three cents per ton on 1886 workings.

The total amount of rock hoisted during the year was 173,874 tons, or 1.256 tons less than in 1886.

The percentage of mineral in ton of rock hoisted was 1.37-100 per cent.

Further particulars are given by Captain J. Vivian, our agent, who has attended to the affairs of the company the past year with his usual energy and skill.

Respectfully submitted,

For the Directors,

D. L. DEMMON, Treasurer.

Office of the Franklin Mining Co., Houghton County, Hancock, Mich., January 5, 1888.

D. L. Demmon, Esq., Treasurer:

DEAR SIR,—The following report of our doings for the year ending December 31, 1887, with the map of the mine showing the extent of the openings, stopes, etc., with inventory of supplies, tools, real estate and machinery; also tabular statements giving in detail the cost of each department of our works, together with a general description of our operations, is respectfully submitted.

SURFACE.

All in this department remains about the same as it was a year ago, except the laying down for fire purposes, of 2,450 feet three-inch gas pipe, connecting with seven hydrants, and extending from the engine to different parts of the location. With this arrangement the most important and valuable property on the mine can be reached with about two hundred feet of hose.

MACHINERY.

At the date of my last annual report, I did not suppose that any addition to our hoisting machinery would be necessary for 1887, but after increasing the depth of the mine about two hundred feet, we found that we had reached the point from where it would be impossible for our present hoisting engine to do the work required without carrying a higher pressure of steam on the boilers than was considered safe. Therefore we purchased from the Portage Lake foundry the heavy pieces for a 24"x48" Corliss engine, which is the same size as the one now in use. All the small parts we are making in our shops, thereby saving in the cost of it about one thousand dollars. It will be connected to the same shaft that the old engine is now operating, and will be ready for use about the 15th of January. On the 22d of May we had an accident to the hoisting engine, the key seat of the pinion giving out and bending the fly-wheel shaft, which disabled one hoisting drum for about four weeks, and necessitated putting in a new shaft, which was done in June. Since then, all in that department has worked very satisfactorily. The fire-box of the pumping engine boiler becoming too poor for further use has been replaced by a new one. All the machinery is in good repair.

STAMP MILL.

We have treated 137,137 tons of rock, which is 1,248 tons less than was stamped in 1886. The falling off was owing to the accident to the hoisting engine as stated above. The mill, except the foundation of two of the heads, which will be repaired in a few days, is in a very fair condition. For the want of sufficient sand room in front of the mill, we have put up a sand wheel sixteen feet diameter, to elevate the sand to a point where it is carried by means of about one thousand feet of launders in another direction. With this arrangement we have sand room for about two years; after that we can elevate it twenty feet higher and deposit it on the old sand pile, where there is ample territory for all the sand the present mill can produce for at least twenty years.

MINING.

The openings made are as follows:

Sunk in shafts	440 feet.
Drifting	1-10 feet.

The amount of rock hoisted was 173,874 tons. The amount rejected was 36,737 tons, or 21 per cent. of the amount taken out of the mine. The cost of manipulating a ton of rock hoisted was 1 87-100 dollars, which is a saving of three cents per ton over 1886, or a total of 5,216 22-100 dollars for the year. The percentage of ingot copper in the rock hoisted was 1 12-100, which is a decrease of 9-100 per cent. from 1886.

No. 3 shaft has been sunk from the twenty-seventh to a point of thirty feet below the twenty-ninth level. On account of the lode bending off to the west, the shaft has been sunk in the foot wall, consequently we cannot say much in relation to the value of the lode until we have seen more of it, except at the twenty-ninth level, where it has been opened for thirty feet north of the shaft, without showing anything of much value.

No. 5 shaft has been sunk from a point thirty feet below the twenty-sixth level to the twenty-eighth. The lode in this opening is large, and full as rich as is usually found in this part of the mine. The openings by drifts have been regularly made from the twenty-fourth to the twenty-eighth level, both north and south of No. 5 shaft, which on the whole have exposed a very fair sized lode that will produce a large amount of all grades of copper, and pay well to remove by stopes. The drifting done at No. 3 shaft is from the twenty-sixth to the twenty-ninth level. The lode in these openings is about the same in size and productiveness as this part of the mine has afforded for many years. The lode in the twenty-ninth level north of No. 2 shaft is rather lean on the whole, but with anything like the present price for copper, some of it exposed in this opening will pay to take out. The depth of the shafts are as follows: No. 2, 2,350 feet; No. 3, 2,320 feet; and No. 5, 2,200 feet.

PROSPECTS FOR 1888.

On account of some portions of the lode in the bottom levels at No. 2 shaft not showing as well as was met with in the levels above, I doubt if the product for the ensuing year will be as large as it was for 1887, but with the present price for our product the profits for 1888 will doubtless be materially augmented.

Capt. Thomas Dennis, Mr. Arno Jaehnig, the clerk, and Mr. James Moore are still with us, and I take pleasure in saying that they have as in former years faithfully worked for the best interests of the company.

I am, yours respectfully,

J. VIVIAN, Superintendent.

Franklin Mining Company, Cash Account for the Year Ending December 31, 1887.

Cash on hand January 1, 1887	\$22,330	70
Cash received from sales of copper, 4,797,289 lbs., at 11.4305c	548,234	26
Cash received from sales silver	4,046	59
Cash received from interest	698	77
Cash received from loans	841,000	00
	\$916,310	32

Contra.	
Cash paid dividend January 1, 1887.	\$40,000 00
Cash paid mine agent's drafts	328,895 36
Cash paid loans	341,000 00
Cash paid interest	4,498 04
Cash paid insurance	919 51
Cash paid storage	882 75
Cash paid smelting	41,710 28
Cash paid freight	12,589 22
Cash paid expense, brokerage, taxes.	12,308 69
Cash on hand December 31, 1887	133,506 47
	\$916,310 32
E. & O. E., Boston, January 2, 1888. FRANKLIN MINING Co., by D. L. Demmon, T	reasurer.
Franklin Mining Company, Profit and Loss Account for the Year 180	37.
Receipts.	
3,475,664 lbs. copper sold at 11.942c	\$411,602 57
440,174 lbs. copper on hand (sold)	74,521 46
Silver sold	2,045 39
Received for interest	698 77
s .	\$488,868 19
Expenditures.	
At mine, as per yearly cost sheet	\$ 325,107 71
All other expenses, including smelting, freight, insurance, interest, etc.,	72,908 49
Profit and loss – Profit for 1887.	90,851 99
	\$488,868 19
E. & O. E. D. L. DEMMON, T	reasurer.
Franklin Mining Company, Assets and Liabilities, December 31, 1887.	
A 88et 8.	
Assets.	
Cash on hand	\$133,506 47
Cash on hand	\$133,506 47 74,521 46
Cash on hand Copper (sold) Supplies at mine	\$133,506 47 74,521 46 73,395 67
Cash on hand	\$133,506 47 74,521 46 73,395 67 30,000 00
Cash on hand Copper (sold) Supplies at mine	\$133,506 47 74,521 46 73,395 67
Cash on hand Copper (sold) Supplies at mine Notes receivable	\$133,506 47 74,521 46 73,395 67 30,000 00
Cash on hand. Copper (sold). Supplies at mine. Notes receivable. Liabilities.	\$133,506 47 74,521 46 73,395 67 30,000 00
Cash on hand. Copper (sold). Supplies at mine. Notes receivable. Liabilities. Drafts accepted and in transit. Liabilities at mine. \$18,597 01 Liabilities at mine. 24,722 71	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60
Cash on hand. Copper (sold). Supplies at mine. Notes receivable. Liabilities. Drafts accepted and in transit. \$18,597 01	\$133,506 47 74,521 46 73,395 67 30,000 00
Cash on hand. Copper (sold). Supplies at mine. Notes receivable. Liabilities. Drafts accepted and in transit. Liabilities at mine. \$18,597 01 Liabilities at mine. 24,722 71	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities Drafts accepted and in transit \$18,597 01 Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60
Cash on hand. Copper (sold). Supplies at mine. Notes receivable. Liabilities. Drafts accepted and in transit. Liabilities at mine. 24,722 71 Due for smelting and freight. Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. Demmon, T	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 \$259,988 00 reasurer.
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities. Drafts accepted and in transit Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88 Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. DEMMON, T Yield in 1881 2,667,952 lbs. refin	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 \$259,988 00 reasurer.
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities. Drafts accepted and in transit Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88 Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. DEMMON, T Yield in 1881 2,667,952 lbs. refit Yield in 1882 3,264,120 lbs. refit	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 \$259,988 00 reasurer. ed copper.
Cash on hand Copper (sold) Sapplies at mine Notes receivable Liabilities. Drafts accepted and in transit Liabilities at mine 24,722 71 Due for smelting and freight Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. DEMMON, T Yield in 1881 2,667,952 lbs, refir Yield in 1882 3,264,120 lbs. refir Yield in 1883 3,489,308 lbs. refir	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 51,435 60 \$259,988 00 reasurer. ed copper. ed copper.
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities. Drafts accepted and in transit Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88 Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. Demmon, T Yield in 1881 2,667,952 lbs. refir Yield in 1883 3,489,308 lbs. refir Yield in 1884 3,748,652 lbs. refir	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 51,435 60 \$259,988 00 reasurer. end copper. end copper. end copper.
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities Drafts accepted and in transit \$18,597 01 Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88 Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. DEMMON, T Yield in 1881 2,667,952 lbs. refit Yield in 1883 3,264,120 lbs. refit Yield in 1884 3,748,652 lbs. refit Yield in 1885 3,999,172 lbs. refit Yield in 1885 3,999,172 lbs. refit	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 \$259,988 00 reasurer. end copper. end copper. end copper. end copper.
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities. Drafts accepted and in transit Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88 Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. DEMMON, T Yield in 1881 2,667,952 lbs. refin Yield in 1883 3,264,120 lbs. refin Yield in 1884 3,748,652 lbs. refin Yield in 1885 3,999,172 lbs. refin Yield in 1885 4,264,297 lbs. refin	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 \$259,988 00 reasurer. red copper. red copper. red copper. red copper. red copper. red copper.
Cash on hand Copper (sold) Supplies at mine Notes receivable Liabilities Drafts accepted and in transit \$18,597 01 Liabilities at mine 24,722 71 Due for smelting and freight 8,115 88 Surplus December 31, 1887 From which a dividend of one dollar per share, on \$40,000, was paid January 2, 1888. E. & O. E. D. L. DEMMON, T Yield in 1881 2,667,952 lbs. refit Yield in 1883 3,264,120 lbs. refit Yield in 1884 3,748,652 lbs. refit Yield in 1885 3,999,172 lbs. refit Yield in 1885 3,999,172 lbs. refit	\$133,506 47 74,521 46 73,395 67 30,000 00 \$311,423 60 \$259,988 00 reasurer. red copper. red copper. red copper. red copper. red copper. red copper.

The Franklin mine has produced as follows:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1857	3	699	1873	183	
1858	56	1,104	1874	2 3	1,790
1859	116	1,211	1875	583	800
1860	157	1,860	1876	963	641
1861	788	43	. 1877	1,169	, 1,817
1862	733	645	1878	1,299	1,528
1863	639	684	1879	1,414	1,703
1864	605	1,335	1880	1,168	466
1865	779	1,481	1881	1,338	1,932
1866	819	994	1882	1,632	120
1867	701	455	1883	1,744	1,308
1868	737	1,326	1884	1,882	1,697
1869	779	970	1885	1,999	1,172
1870	589		1886	2,132	297
1871	300	1,000	1887	1,975	1,832
1872	186				
Total				27,740	310

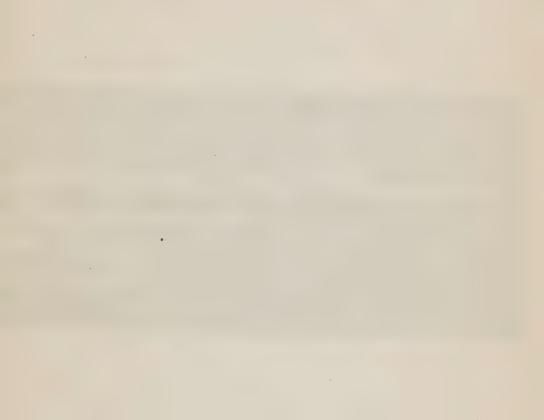
D. L. Demmon, Secretary and Treasurer, Boston, Mass.

THE PEWABIC MINING CO.

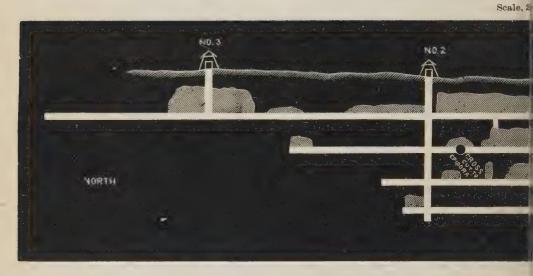
The Pewabic mine lies between the Franklin and the Quincy and was formerly a very rich amygdaloid mine, but becoming exhausted additional land was purchased nine years ago and the shaft extended down into it and levels opened. Unfortunately this ground did not prove productive, while the expense of the purchase and of the new openings was considerable. The company became financially embarrassed.

The affairs of the company have been in the courts for some years past and are yet far from settled. Its man-engine shaft and air compressor are used by the Franklin company.

The Quincy mine is several hundred feet deeper than the Pewabic and is rich in the bottom which suggests that, possibly, the Pewabic will also be found productive at greater depth. The east branch which is so rich in the Quincy is also found in the Pewabic. It would seem to be advisable, that whoever works the Pewabic in future should test this east branch pretty thoroughly at every level. The machinery, Capt. Vivian says, is in good repair, and the mine could be started up without much expense; but paying ground would have to be found before a profit could accrue. The mine has been shut down since July 12, 1884.



LONGITUDINAL SECTION OF



PENINSULA MINE JAN., 1888. one inch. STAMP MILL ROCK HOUSE SOUTH



\$70,989 41

The mine has produced in all, 13,894 tons, 620 lbs of copper.

D. L. Demmon, Secretary and Treasurer; Johnson Vivian, Agent.

THE HANCOCK MINE

has not been worked for several years, and I know of nothing of interest to be related of it beyond what is found in previous reports.

THE PENINSULA MINE,

which was shut down in 1884, is again to be worked. The water has been pumped out and things are otherwise getting into readiness to work the mine.

The mine lies south of the Osceola and is in the Allouez conglomerate. The openings are not very extensive, the lowest being only the 6th level, which latter was drifted in to but a slight extent.

I have been into the mine several times and have seen good stopes, reasonably rich conglomerate. Certainly if enough of such kind of ground could be opened up, the Peninsula would be a paying mine. A history and description of the mine will be found in former reports. The stamp mill is first-class. The other machinery, rather out of date. The mine has produced 1,543 tons, 1,071 lbs of copper.

W. A. Dunn, Agent; S. D. North, President, Hancock, Mich.

THE OSCEOLA MINE

from the outset to the present time has been, and remains, one of the leading copper mines of the state. Intelligence, vigor, push, have characterized the management, and there have been no reverses. I have described the mine very fully in former reports. It is a good place to study mining, progressive work. The company's report is so complete for the year's work that little is left to be said.

OSCEOLA MINE REPORT.

The directors present the following report of the operations for the past	year, and
statement of the financial condition of the company:	
The product of material was 4,184,432 pounds, which at 85.65 per cent. gave 3,583,723	
pounds refined copper, for which has been realized the gross sum of	\$424,936 85
From sale of building lots at Hancock	199 50
	\$425,136 35
The costs have been:	
Running expenses at mine\$297,684 31	
Smelting, transportation, and all other exdenses of selling copper 56,462 63	071410 01
	354,146 94

Showing a mining profit of

The balance of assets January 1, 1887 was		\$225,741 99	
There has been expended in exploratory work,	\$6,513 03		
There has been expended in mine plant during the year	4,702 22		
Deduct dividend of February 15, 1887	50,000 00	61,215 25	
			164,526 74
Making the balance of assets January 1, 1888			\$235,516 15

A dividend of \$1 per share, or \$50,000, payable January 16, has been declared from the earnings of the past year.

There are no matters of interest or importance to record during the past year. The failure to find a paying lode in the cross-cut from 16th level was a great disappointment to many of our share-holders, but, after all, it was known by every one to be only an exploration, and does not preclude the possibility or even the probability of reaching important results in the future. As has been said in former reports, the great Calumet and Hecla conglomerate lode crosses and out-crops on the entire length of our property. With a belt of the formation so unique and wonderful, further explorations must surely be made in the future at greater depth, and one would be bold indeed who should decide that great results are not yet in store for the Osceola from this world-wide famous conglomerate lode.

The enormous advance in the price of ingot copper makes it certain that Captain Daniell acted wisely in placing his power and machinery at work "where it would do the most good" in the output of fine copper, with the certainty of ample remuneration. While we should remember that our mine is lean and bunchy in its characteristics, yet we should not forget that the lode going south and in depth shows gradual improvement, and the greatest portion of our estate is in this direction. We are justified in indulging hopeful anticipations for the future. We shall, no doubt, the coming season, open another shaft (No. 5) south, on the Opechee property, with reasonable ground of hope for improved conditions. Meantime, with present output and price of ingot copper, we can hardly fail to realize reasonable returns in dividends. The report of Captain Daniell and the treasurer will show our affairs to be in a healthy and conservative condition.

ASSETS AND LIABILITIES.

A886t8.		
Dash in bank at Boston	\$15,608 36	
Cash on hand at mine	339 49	
Supplies on hand at mine	22,056 63	
Fuel on hand at mine and stamp mill	20,205 96	
Accounts receivable at mine	9,007 10	
Bills receivable at Boston	90,916 28	
3,000 shares stock in Tamarack-Osceola Copper Mfg. Co	7,500 00	
250 shares Hancock and Calumet R. R. stock	25,000 00	
Copper on hand, 724,002 pounds, since sold	109,958 52	
Total assets		\$300,592 34
Liabilities.		
Drafts outstanding	\$12,892 39	
Accounts payable at mine	31,880 30	
Bills payable at Boston	20,000 00	
Dividends uncalled for	303 00	
Total liabilities		65,076 19
Balance of assets January 1, 1888		\$235,516 15

STATEMENT OF RECEIPTS AND EXPENSES OF ALL KINDS FROM SEPTEMBER 25, 1873, TO JANUARY 1, 1888.

Receipts.

receipts.	
From capital stock, \$50,000 shares, \$25 a share full paid.	\$1,250,000 00
" 936,002 pounds copper, 1874, at 23.37c \$218,736 92	
" 1,330,313 " 1875, " 22.77c 302,862 96	
" 1,693,737 " 1876, " 20.57c	
2,114,111 18.190	
420,340 14	
0,00,009 09	
0401,001 1000, 19.10C	
±,110,710 1001, 11.77C	
4,177,102 1004, 11.100	
10009 11.000-11.000-11.000-10.0	
" 4,247,630 " 1884, " 12.82c 544,651 02	
" 3,560,786 " 1886, " 10,51c	
64 3,583,723 4 1887, 4 11.86c	
11,000,100	6,682,268 86
Suitos of Sirver to date	32,439 04
interest receipts to date	36,220 87
500 Shares Halloock & Calumet L. Iv. Stock	36,000 00
Total receipts	\$8,036,928 77
Tomassa	
Expenses.	
Running expenses prior to 1887 \$5,130,925 73	
Running expenses during 1887	
Construction expense prior to 1887	
Construction expense during 1887	
*, 100 xx \$714,536 44	
Real estate	
Dividends prior to 1887	
Dividends during 1887. 50,000 00	
Exploratory work	
	677 OOG 410 GO
Total expenses.	\$7,826,412 62
Balance of receipts January 1, 1888	\$210,516 15
Add 250 shares Hancock & Calumet R. R. stock	25,000 00
Balance of assets January 1, 1888	\$235,516 15
DETAILS OF MINING EXPENSE.	
Chaft sinking 402 2 foot of \$19.90	
Shaft sinking, 462.3 feet at \$12.26. \$5,668.90 Winze sinking, 217.5 " " 9.95. 2,165.10	
Drifts, 3,820.1 " " 6 58. 25,141 06	
Stoping, 9,502 fath'ms at 9 91	
Tramming 27,147 41	
Timbering, labor, materials, and supplies. 6,940 41 Extra work. 1,391 56	
Supplies, labor, fuel, etc., for air drills	
Supplies, fuel and labor for engines 27,383 81 Mining superintendence and company account labor 19,960 35	
\$239,398 61	
Less profit on supplies 29,284 50	\$210,114 11

Other Expenses.

Otto Dapoteso.		
Rock house	\$18,136 80	
Surface labor, supplies, etc	1,092 60	
Incidental expense, including taxes	6,378 19	
Office labor, supplies, etc	5,802 52	
Transportation	22,641 29	
Stamping	33,518 80	ON KNO 00.
•		87,570 20>
Total running expenses		\$297,684 31
Construction Costs.		-
Dwelling houses at stamp mill	\$2,607 07	
Compressor, boiler-house, etc.	32 98	
Dwelling houses at mine.	2,516 83	
School-house at mine	340 89	
Transfer of engine from No. 3 to No. 4 shaft	289 45	
Stamp mill construction	1,695 00	
Total construction costs	\$7,452 22	
Credit.		
By boiler, engine and dwelling houses sold	\$2.750 00	
		\$4,702 22
Expenses of drifting cross-cut to Calumet conglomerate		6,513 03
Total expended at mine		\$308,899 56
Summary.		
Rock stamped		145,200 tons.
Product of mineral		4,184,432 lbs.
Product of refined copper		3,583,723 lbs.
Yield of refined copper per ton of stamp rock		
Yield of refined copper per cubic fathom of ground broken		
Yield of mineral per cubic fathom of ground broken		
Percentage of mineral in stamp rock		
Percentage of refined copper in stamp rock		_
Cost per ton of rock hoisted.		
Cost per ton of rock stamped		
Refined copper, cost per pound at mine		
Cost of smelting, freight, and all other expenses		1.57c
Total cost per pound of refined copper laid down in New York		9,88c

SUPERINTENDENT'S REPORT.

OPECHEE, February 2, 1888.

To the President and Directors Osceola Consolidated Mining Company:

GENTLEMEN—In compliance with the usual custom I would submit the annual report of the mine for 1887.

After the end of May the stamping for the Tamarack mine at our mill was practically ended. The absence of revenue from this source after the time specified increased our cost of stamping over the preceding year about eight cents per ton. The cost of cross-cutting to and working on the conglomerate, not less than \$8,000, charged to general mining expense, added five cents per ton to the cost of our rock stamped. A somewhat higher rate of underground wages, and increased cost of fuel, with the foregoing, will fully account for the difference of 19 cents per ton on cost of stamp rock which appears.

We got a pound of copper less per ton from the rock handled, than in the preceding

year. This in itself is apparently a small matter, yet the difference is very appreciable on the cost of ingot produced.

The rock hoisted for the year was 171,038 tons, or the equivalent of 9,502 fathoms of ground. The mill product was 3,889,171 pounds mineral. Barrel work obtained 295,261 pounds, or a total of 4,184,432 pounds. This at 85.65, per cent. ingot gave a yield of 3,583,723 pounds. A fathom of ground afforded 377.15 pounds, and a ton of rock nearly 21 pounds of ingot.

The underground work foots up as follows, for the year:

	Shafts	462.3 feet.
	Winzes and rises	217.5 feet.
	Levels	3.820.1 feet.
	Cross-cuts	720.5 feet.
,	Level conglomerate	82.0 feet.
	Total	5,302.4 feet.

Present depth of shafts and sinking for the year is shown in the following:

Shaft.	Sunk.	Depth from Surface.
Number 1		1,387.1 feet, 18 feet below 15th level.
Number 2	161.3 feet.	1,875.8 " 10 " " 21st "
Number 3	100.1 "	1,898.3 " 12 " " 21st "
Number 4	161.3 "	1,696.7 " 70 " " 19th "

The extension of the several levels for the year is shown in the following form; the preponderance of the work being between Nos. 3 and 4 shafts, and south of No. 4 shaft:

11th level	130.2 feet.	16th conglomerate	82.0 feet.
		17th level	
13th "	120.9 "	18th "	398.0 "
14th "	609.4 **	19th "	559.5 "
15th "	309.6 "	20th "	1,100.2 "
16th cross-cut	720.5 "	21st "	194,3 "

No. 2 shaft has been sunk from 19th to 2 ist level. The line of the shaft seems to be about parallel with the lode, but far enough under the productive part of it to show in the sinking copper only now and then. At this time the bottom of the shaft is quite productive. Cutting through the lode at 21st level we find from 8 to 10 feet of copper rock of full average quality. The drivage north of the shaft shows a continuous run of stoping ground at 20th level for nearly 200 feet. This is of about average quality. The 20th level between Nos. 2 and 3 shafts opened stoping ground for the most of its length, more in quantity than usual, but we do not rate it as above the average in quality.

No. 3 shaft now down, and in working order to 21st level, was sunk wholly in the hanging-wall trap. The lode opened at 21st level for about 200 feet in length, is of better than average quality, and quite promising. Stoping ground here also seems to be continuous.

The levels drifted between Nos. 3 and 4 shafts, 18th, 19th and 20th, may be rated as average in productiveness. Lode irregular in width, the runs of copper ground not being longer than we ordinarily find them.

No. 4 shaft is now nearly down to 20th level. From the 16th level to within 20 feet of the present bottom, this shaft was sunk in the hanging-wall trap. At present the

lode is in line of the shaft, and is fairly good for copper. Each level, except 16th, has from 12th down been drifted more or less south of No. 4 shaft. Best results have been noted in 17th, 18th and 19th levels. At 16th level we have had an exceedingly good stope, and we still feel that we may look to the ground south of No. 4 shaft for its fair proportion of our future product.

In the past year we were disappointed in stoping 17th and 18th levels between Nos. 3 and 4 shafts. These were unusually promising, and in places quite rich in the openings. The stopes will no doubt, afford rock of average quality, and in normal quantity, but we had been looking for something better.

The cross-cut at 16th level towards the conglomerate was drifted 720.5 feet, or in all, 740.8 feet, west from hanging-wall of amygdaloid to foot wall of the conglomerate. In October last we cut into the lode and found it from 5 to 6 feet wide, carrying a little copper, but not in quantity to be of any value. Drifting south to the extent of 82 feet has been done, making an exposure, including the cross-cut, of 90 feet. We found in driving south that the lode grew wider and carried a little more copper, but the last 40 feet drifted was the reverse of this. In the extreme end of the opening the conglomerate is less than five feet wide, and can only be characterized as poor. For a month past no work has been done here.

I am sensible of the importance that has been attached to the opening up of this lode, and regret very much that I cannot speak of the prospect in more encouraging terms. I would not say that we are to expect nothing from the Calumet lode in our property, eventually. I have a distinct remembrance of the characteristics of the showing in and about No. 3 shaft of the old mine, and feel satisfied that we must still go deeper to find a paying lode, if it exists for us. Later we shall be in a better position to afford compressed air for the prosecution of work in this connection, if deemed best. Time will throw more light on what steps we had better take.

Returns from the west amygdaloid have gradually fallen off. Have not discontinued work on it, but scarcely expect to make an important discovery here.

Our prospects for the future are as good as the average of last year. While we have no unusually rich ground to fall back on, we feel that of late we have opened more ground that will pay for stoping in proportion to the whole than for a long time. The openings about and between Nos. 2 and 3 shafts are especially promising in this respect. We are also satisfied that our stoping ground continues to extend south, and it will be in order this year to take steps for the sinking of another working shaft.

Through the rock houses we passed 171,038 tons of rock, discarded 25,838 tons, remainder was sent to mill. The cost of manipulation was 10.6 cents per ton, a little under the preceding year.

Stamping amounted to 145,200 tons, and 38,700 tons for Tamarack mine. Total, 183,-900 tons, at a cost for the whole of 35.05 cents per ton. For several months the full capacity of the mill was not utilized. We are now again running the four heads, partly on Tamarack rock.

Our construction account has not been important; a new boiler added to the mill, five dwellings for employés at the mine and same number at the mill.

With this you should receive plans of the mine by our engineer, and a detailed statement of the year's accounts.

Our work has run smoothly for the year. My assistants deserve praise for their untiring devotion to the interests of the company.

Yours very truly,

JOHN DANIELL, Superintendent.

The percentage of cost in the several departments of work are as follows:

1887.	West Amygdaloid.	Osceola Amygdaloid.	Rock House.	Transpor- tation.	Stamping.	Inciden- tals.	Surface.	Office.	Whole No.Men.
Totals	.03364	.67849	.05962	.07443	.011019	.02097	.00359	.01907	374%

Total expenditures in 1887, \$308,899.56.

ROCK HOUSE COST.

Average cost per ton of rock, 10.6 cents; cost of air drill work, total \$26,805.29; transportation expense of rock, paid 15 cents per car for hauling, balance is for loading cars; 145,200 tons of rock, cost of loading, \$861.37; total cost, \$22,641.29, 15.65 cents per ton.

'l'ota	2 4 - 4 1 3 - 3	400 111 07
	l cost stamping, labor	\$26,111 85
	ls of wood used	51,341
	s of coal	4,520
Cost	of fuel	\$30,488 00
Oil f	or lights	10 60
Oil f	or laboratory	1,265 27
Stan	np shoes	1,244 60
Har	dware	243 00
Iron	and steel	2,300 96
Was	ste	278 57
Pack	king and belting	280 41
All	other supplies	2,372 62
Tota	ıl supplies	7,880 95
Amo	ount of labor brought forward	26,111 85
	Total (includes labor and Tamarack rock)	004 480 00
	10tal (Includes labor and Lamarack 10th)	\$64,478 80
Cred	lit stamping tamarack rock	30,960 00
Cred		* '
	lit stamping tamarack rock	30,960 00
Tons	lit stamping tamarack rock	\$33,518 80
Tons	tit stamping tamarack rock	\$33,518 80 145,200
Tons Tota	Iit stamping tamarack rock Total expenses. s of Osceola rock stamped. s Tamarack rock stamped.	\$33,518 80 145,200 387,000
Tons Tota	It stamping tamarack rock Total expenses s of Osceola rock stamped s Tamarack rock stamped	\$33,518 80 145,200 387,000 183,900
Tons Tota Tota	It stamping tamarack rock Total expenses s of Osceola rock stamped s Tamarack rock stamped It tons stamped It incidental expenses	30,960 C0 \$33,518 80 145,200 387,000 183,900 \$6,378 19
Tons Tota Tota	Total expenses	30,960 C0 \$33,518 80 145,200 387,000 183,900 \$6,378 19 5,802 52
Tons Tota Tota	Total expenses s of Osceola rock stamped s Tamarack rock stamped d tons stamped office "surface "su	30,960 C0 \$33,518 80 145,200 387,000 183,900 \$6,378 19 5,802 52 7,944 18
Tons Tota Tota	Total expenses s of Osceola rock stamped s Tamarack rock stamped ll tons stamped ll incidental expenses office " surface " construction account at mine " " on mill.	30,960 C0 \$33,518 80 145,200 387,000 183,900 \$6,378 19 5,802 52 7,944 18 3,180 15
Tons Tota Tota	Total expenses s of Osceola rock stamped s Tamarack rock stamped ll tons stamped ll incidental expenses office " surface " construction account at mine " " on mill.	30,960 C0 \$33,518 80 145,200 387,000 183,900 \$6,378 19 5,802 52 7,944 18 3,180 15 1,665 00

Annual products of the Osceola mine are given in the following table:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1874	468		1881	2,089	1,876
1875	665	303	1882	2,088	782
1876	846	1,737	1883	782	2,128
1877	1,382	777	1884	2,123	1,630
1878	1,352	1,998	1885	969	1,169
1879	1,589	1,387	1886	1,780	786
1880	1,691	1,387	1887	1,791	1,723
Total			}	20,978	214

TAMARACK MINING CO.

The Tamarack mine has been the subject of more interest for the past few years than any other mining enterprise in the state.

Its success has given general gratification, and the original boldness of the scheme, the vigor and skill with which the work of sinking the shaft was executed, excited universal admiration and has brought great and deserved profit as well, no doubt, to the promoters of the undertaking. The Tamarack mine has been a good educator in several ways. It was a radically bold project thoroughly reasoned out from the inception, and rapidly, economically, and successfully brought to a conclusion.

It was the first instance of extraordinary deep sinking, and has thus been an important lesson in this branch of mining. It has demonstrated the fact of the continuance of the copper charged conglomerate to great depth and the persistence of these mineral "shoots" in their assumed course through the conglomerate belt down into the earth. The Tamarack company, with commendable openness and liberal intelligence, has been free to give to the public the entire results of the work, including the details of cost both of the primary sinking and preparation, and subsequently of the production of copper as well. With the exception of the Calumet and Hecla, all the copper mining companies have uniformly done this; but the Calumet and Hecla, working in this rich conglomerate, has persistently withheld from the public all statements and figures which could be used as certain data from which to determine the cost of the copper.

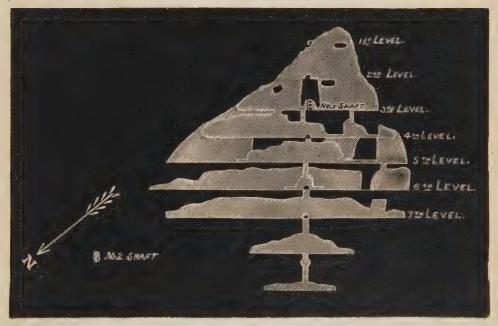
The Tamarack is in the same conglomerate, adjacent to the Calumet and Hecla, and the public is fully informed of the cost of the copper and of all the details pertaining to its production, of the extent of the mine, and of the percentage of yield of the rock. To all persons interested in the geology of the country, in the problems of mining, in the value of stocks, in investments, etc., this work by the Tamarack company, and the information which it disseminates, is invaluable.

With the exception of the Tamarack, the Calumet and Hecla is the only mine in this conglomerate, which is far richer than any other deposit. The mine produces more copper than all the others combined, so that all facts pertaining to it, and to its working, are of great scientific and financial interest, and for years it has remained a matter of general regret that the company should withhold from the public all information possible regarding it. Fortunately the Tamarack company is governed by a different policy.

It may be well to briefly describe the situation of the mine and to reiterate a few words giving its history.

LONGITUDINAL SECTION OF THE TAMARACK MINE, JAN., 1888.

Scale, 300 ft. to one inch.





The so-called Calumet and Hecla conglomerate is, as its name implies, a belt of conglomerate rock which in this portion, is richly impregnated with copper and which conforms in strike and dip with the other formations with which it is associated, bearing north about 33° east and dipping northwesterly at an angle of about 37° with the horizon. Along the line of the outcrop of this remarkable deposit the Calumet and Hecla Co. owns a length of upwards of two miles, across the whole of Section 23 and the corners of Section 14 and 15 in T. 56 N., R. 33 W.

To the north and south of these limits the conglomerate, as far as tested, has not proved productive in copper, but portions of the belt possessed by the Calumet and Hecla company are very rich, and nearly all of it holds copper. The so-called "copper shoots" are the portions of the belt which contain the mineral in the greatest quantity, and these mineralized portions usually have a certain direction in the main body of the rock; that is, the portions of the deposit charged with the copper do not extend down usually at right angles to the strike of the formation but at an inclination to the north or to the south. In the Calumet and Hecla the copper shoots incline down to the north, and one of the points to favor the project of the Tamarack shaft was the supposition that the "copper shoot" at the south side of Section 23, known as the "Black Hills," or South Hecla mine, would hold its course, and hold its richness, and could be reached by a deep shaft from the surface.

The nearest point at which the Tamarack company could reach the lode was in the S. E. corner of the west half of the S. W. 4 of Section 14, and it is here the shaft was located and sunk. It penetrated to a vertical depth of 2,270 feet before the conglomerate was struck, June 20, 1885, three and a half years from the date of commencement of the work.

The shaft is 19 feet x 7 feet inside the timbers, divided into three compartments, all of which are furnished with a cage descending to the bottom of the mine and one of them being operated by a separate plant of machinery.

A detailed description of this shaft and the work of sinking it is given in my report for 1885.

The shaft intersects the conglomerate in the corner of the property from which the company's boundaries run north and west, while the copper lode dips away to the northwest. Thus the successive levels, or horizontal drifts in the lode, which run diagonally across the corner of the property from the south line to the east line, increase in length with the increase in depth of the mine. The shaft descends vertically in the foot wall, and the lode is reached from it by "cross-cut" drifts which of course are longer, successively, as they go down.

The mine has proved all that was anticipated, the most favorable, regarding

it. The lode is as wide, as uniform, and as rich in copper, as any estimates had placed it. Altogether the Tamarack was a notable scheme, of much value to the country, very creditable to the owners, and a triumph of the energy and skill of Capt. Daniell, who directed the execution of the work.

The accompanying plan of the mine gives a clear idea of the underground work. It represents the mine laid on the foot wall and shows the position of the shafts and the intersections of the cross-cuts with the levels. The plan is to take out all the rock that is of any value, thus leaving only the bunches of sandstone, which occur in the conglomerate.

I went through the mine in March last, and found it looking extremely well; certainly as good in the bottom, at the 9th level, as any where. In February the average of mineral obtained from the rock-was 5%, 3.77% ingot copper. The 9th level gives a length of ground of 1,500 feet between the boundaries. From this time on the company will be able to work to better advantage. The mine is becoming larger, giving more room, more stoping ground, so that they can mine far more rock hereafter. For instance the 9th level gives a working length of 1,400 feet, and the height, converging somewhat, to the 8th level, is 106 feet.

No. 2 shaft is down 1,200 feet; it will intersect the lode at a point below the 8th level, where the drift connecting the shafts will be 600 feet long. The shaft is slightly smaller than No. 1, inasmuch as there is no room for pipes reserved, but it will be in three compartments.

In No. 1 there is a down draught of air in two compartments and an up draught in one; the temperature in the mine is 62° to 65° Fahrenheit.

In No. 3 stamp head, recently added in the mill, the company has admitted a departure in the foundation.

E. P. Allis & Co., of Milwaukee, the makers, have placed a solid foundation to receive the blow. The difficulty with timbers is, that the stamp does constantly less work. The spring becomes too much, and the blow is less and less effective as the stamp is used. Allis & Co. have persuaded Capt. Daniell to consent to the trial of the stamp head with a foundation as immovable as possible. The spring timbers are done away with. The matter had been decided upon when I was at the mine last, in April. Since then the work has been completed, and the work of the new head is said to be all that was claimed for it. It is the first instance of the kind of a heavy stamp head being used without a mortar or anvil of spring timbers to receive the blow.

It is believed that with this foundation more rock will be passed in a given time than with the ordinary one.

The Tamarack has a remarkable record in the matter of profit and loss. The conglomerate was reached in June, 1885, and already the mine is in the

dividend paying list. The money received from the sales of the copper produced has amounted to enough to cover all the outlay from the beginning, inclusive of the entire cost of sinking the shaft, the machinery, buildings, &c., besides leaving in the company's treasury a considerable surplus from which to pay dividends and defray contingent expenses.

The following is taken from the company's report of operations from Jan. 1 to July 1, 1887:

Mineral produced	6,232,119 lbs.	
Ingot copper, 74 per cent. of mineral	4,636,521 lbs.	
Which sold for the sum of	\$474,614 68	
Running expenses of the mine		
Smelting, transportation, and all other expenses.	79,684 18	
Mining profit	94,032 47	
Add balance of assets, July 1, 1886	100,599 54	
Add 250 shares of Hancock and Calumet R. R. stock	25,000 00=	\$125,599 54
Total	\$219,632 01	
Deduct amount expended in mine plant during the year		\$194,186 75
Leaving a balance of assetts of		\$25,445 26

The stamp mill has been in operation since May 15, 1887, and we deem that our plant is the most effective and inexpensive of any on the lake, or in the country.

We say this in full consideration of the fact that enormous amounts of money have been expended by our competitors, in pursuit of a common object, which has been, and is, and will be, the production of fine copper at the lowest cost per pound. This is the test and standard by which all the producing companies must be judged in the long run. Our neighbor, the Calumet and Hecla, is really the only mine with which any sort of comparison can be made. It is, by far, the most extensively developed mine in the country, and nearly so in the world. Its product of fine copper the past year has been over 2,000 tons per month. It has absolutely unlimited resources in capital, and has been worked over twenty years with unfailing success. The conditions of the two mines are marvellously similar, excepting where the advantage is altogether against us.

In the first place our vein or lode is identical in character and location, but we had what a few years back was considered an absolutely insurmountable disadvantage, that of being over 3,500 feet below them, on the dip of the lode. On their location the vein outcrops on the surface, giving access to the copper from the start, and so following it down on the incline, while our surface is in reality some 2,500 feet underground (vertical), and is reached only by a single shaft through solid and unproductive rock, through which every ton must be brought to the surface, to be treated at the stamp mills and smelting works. The Calumet and Hecla has access to its mine by twelve shafts, while we have but one, and yet, such is the superiority of vertical shafts, and of our system of working, that our two shafts (we have a second already more than 700 feet deep, which will be available within two years) in our opinion will be equally as effective in hauling rock to the surface, as the whole twelve shafts now working at the Calumet and Hecla. Treatment at the surface, as crushing rock and smelting mineral, is the same at both mines. Now if Tamarack can, in its first year, as a producing mine, with a single shaft, be made to yield 500 tons per month, as cheaply per pound as its old and rich neighbor can produce four times that quantity, does it not prove that Tamarack, young and insignificant as it is, by comparison, has achieved marked success? It should not be forgotten that Tamarack has but 40,000 shares, while Calumet

and Hecla has 100,000 on which to make its dividends. It will be remembered that two years ago it was voted to increase the capital by issuing 10,000 additional shares for the purpose of improving our facilities for smelting and handling our output of fine copper. It is now believed that this object will be attained without resorting to this expedient, and the 10,000 shares will remain, as voted by the stockholders, subject to the disposal of the directors, and will not be issued.

Calumet and Hecla has a most memorable record. Indeed, it is to-day one of the most so in history. It is a very old mine, as such matters are now considered in this country, and yet it is really a young mine. It was first opened before the consolidation in 1866, by comparatively feeble and inexperienced hands, in a remote wilderness, winter region, shut out from the commerce of the world absolutely for one-half of the year. Scientific knowledge in the peculiar work of mining for pure metal, and not for ores or mineral, was necessarily in its babyhood. A million or so of money was paid in by reluctant shareholders before the real history began to attract the world's notice. Capital and science had their legitimate results in marvellous success. In the course of its history it has returned to stockholders in cash over twenty-nine millions, and stands to-day by the price of stock as the representative of more than twenty millions more. It has spent vast sums with a more than liberal hand in opening and developing. To-day it is one of the richest mines in the world, both in its present development and production, and future promise.

Now it may be asked with great propriety, What has this wonderful history of development and success to do with Tamarack? We think the question will be answered, when the significance of the fact is considered, that their twelve shafts all dip, on the incline, ultimately into Tamarack property, and it will be reached in the future just as our shaft proved it at 2,000 feet in depth, after some years' work in barren solid rock, at the precise spot anticipated. At the very outset, before machinery has been fairly started, having overcome the great obstacle of depth, we have demonstrated that we can produce copper certainly at as low cost per pound as any competitor. We feel that this matter, so imperfectly understood and appreciated generally, should not be lost sight of. It is true that it will take long years for us to develop and realize their remunerating results, but it is not less true that we have passed the crucial point of our history, and are to-day earning far beyond our current and construction expenses for dividends in coming years.

The new stamp mill has but two heads, which have been in operation for less than three months. The cost of the mill was about \$110,000, and is designed for four heads, or may be arranged for six or more heads, but at present the mine does not supply sufficient rock for the two heads. In July, 1887, we crushed 9,375 tons of rock, yielding 668,000 pounds of copper, worth 10½ cents per pound—\$70,000, and which cost \$40,000 to produce, including mining, stamping, smelting, freight and commission, and \$13,000 for construction. This gives the cost per pound for the copper 6 cents.

ASSETS AND LIABILITIES.

Cash in bank at Boston	\$4,036	27
Hancock & Calumet R. R. Co. 6 per cent. bonds	55,000	00
Assessment No. 1	93	00
Supplies on hand at mine	31,823	78
Cash on hand at mine	811	74
Accounts receivable at mine	7,105	32
Wood and timber land	15,731	96

250 shares H. & C. R. R. stock Bills receivable	,	
Copper on hand	195,748 60	
Total cash assets		\$381,712 59
Liabilities,		
Drafts outstanding		
Accounts payable at mine.	,	
Bills payable Loan account		
Total liabilities		356,267 33
·		
Balance of assets July 1, 1887		\$25,445 26
STATEMENT OF RECEIPTS AND EXPENSES OF ALL KINDS, 1882 TO	JULY 1, 188	7.
Receipts.		
From capital stock, 50,000 shares, \$13.00 a share paid in		\$650,000 00
" 363 pounds copper, 1882, at 18.00		
" 7,435 " 1883, at 14.71		
" 1,979,400 " 1885-6, at 10.05 " 4 636 521 " 1886-7 ot 10.21		
4,000,001		
" 6,623,719 " total, at 10.19		674,717 95
From interest receipts, 1882	\$832 83 592 44	
" " 1884		
1885 (6 months)	506 92	
66 66 66 1885-6	2,581 12	0.7.00 50
From 350 shares Hancock & Calumet R. R. Co.'s stock sold and paid for		6,169 50 35,000 00
250 shares Hancock & Calumet R. R. Co.'s stock on hand		25,000 00
Total receipts		
Expenses,		V -,,
Running expenses prior to July 1, 1886		
Running expenses during 1886-7		
Construction expenses prior to July 1, 1886\$152,633 67	\$688,621 77	\
Construction expenses during 1886-7		
No. 2 shaft	346,820 42	
Real estate		
Total expenses.		1,365,442 19
		\$25,445 26
Balance of receipts July 1, 1887		\$20,440 20
DETAILS OF MINING EXPENSE.		
Underground Expenses.		
Shaft sinking, 175.2 feet, at \$24.86	\$4,355 60	
Winze sinking, 674.6 feet, at \$12.73.	8,591 15 24,081 45	
Drifts, 2,260 teet, at \$10.65	55,823 69	
Tramming	16,699 81	
Timbering, labor, materials and supplies	26,340 14	
Extra work	4,778 47	
Supplies, fuel and labor for engines	23,653 59	
Mining superintendence, and company account, labor	17,474 00	
Blacksmith, machinist and carpenter labor	2,829 59	
- Ol V -	\$209,959 48 19,810 55	
Less profit on supplies.	10,010 00	\$190,148 93

Other Expenses.

Rock house Surface labor, supplies, etc Office labor, supplies, etc Transportation Stamping Incidental expenses Taxes	7,346 13 16,952 04 69,572 87 791 16 5,250 86	110,749 10
Total running expenses		\$300,898 03
Construction Costs.		
No. 1 auxiliary engine		
No. 2 shaft and equipment		
Electric light plant		
Rock house	1,280 34	
Change house		
Dwellings		
Compressor	1,458 84	
Machine shop.	993 82	F
Carpenter shop	1,723 79	
Blacksmith shop.	1,964 56 412 86	
Office		
Number 1 engine and shaft equipment.	1,487 54	
Third compartment, Number 1 shaft		
Private dwellings	3,815 96	
New boilers		
Number 2 auxiliary engine		
Total construction costs	* '	
Number 2 shaft	22,718 22	194,186 75
Total expended at mine		\$495,084 78
•		
Summary,		
Rock stamped		
Product of mineral		
Product of refined copper		
Yield of refined copper per cubic fathom of ground broken		831 lbs.
Yield of refined copper per ton of stamp rock		51.18 lbs.
Yield of mineral per cubic fathom of ground broken		1,116 lbs.
Percentage of mineral in stamp rock		
		_
Refined copper, cost per pound at mine		6.49 cents.
Cost of smelting, freight, commission, and Boston expense		
Total cost per pound of refined copper laid down in New York and sold.		8.21 cents.

The cost of producing and treating rock has steadily decreased as the output has become greater; \$3.32 per ton as against \$4.00 per ton the previous year. From present outlook \$3.00 per ton will be the maximum cost for handling rock.

The amount of rock handled during the year ending June 30, 1887, was 106,802 tons, 6,850 tons of which came from the walls of the enclosing rock, much of it being left underground; 100,452 tons went to the rock house, and after assorting 90,587 tons were sent to the mill. The number of fathoms broken in the conglomerate was 5,5803, which yielded 831 lbs. of ingot to the fathom. Number of copper boulders selected during the year, 187,164.

No. 1 shaft is, August 31, 2,490.7 feet deep, and No. 2 725 feet deep, the latter having been sunk 517 during the year, using one drill.

There is nothing special to be noted about the beds of rock passed through in sinking No. 2. No copper belts of apparent value have been cut. We have rather more water than in No. 1 shaft and the rock seems firmer, requiring less timber.

To the rock house, in the last year, we have added one 10" x 15" breaker, and now have nearly ready a hammer for breaking the largest-sized rocks. This plant may be regarded as complete, and is assuredly quite efficient. It cost 9.62 cents per ton to pass rock through the house.

Transportation expense is but little in excess of 18 cents per ton. For the current year this will be less, the larger output insuring a reduction of the rate.

We continued stamping at the Osceola Mill until 18th May last, so that we have but little to report respecting our own operations. The cost at Osceola was 80 cents per ton. The charge for the year was 76.8 cents per ton.

We are counting on stamping for 50 cents per ton when the two heads are fully supplied with rock. This of itself will be an important reduction of expense. The new stamps will crush, each head, in excess of 200 tons of conglomerate daily, probably more than 225 tons. Up to the present we have not tested its full capacity. Results attained in first two months' running are misleading. Expenses have been comparatively higher than what would be rated as regular.

Construction account, as you know, has been heavy. Nor is it possible to equip a mine of this magnitude without spending large sums of money.

The stamp mill is the most important of our improvements. The building is large enough for three heads of stamps and the accompanying dressing machinery. Bin capacity for five heads has been provided. Boiler-house contains three large boilers, uniform in size and style with those at the mine. Room for another exists. Stamps, two heads, are wholly of iron, 20" cylinders. Fifty-six washers (jigging machines) have been put in, and six Evans' Slime tables for treating the finer material. Pump is large enough to supply three heads of stamps, and is in a separate building. Electric light plant has just been put in. Everything is of the best quality, and should do good service.

At the mine the improvements outlined in last year's report have been completed. We have in addition put in a boiler at No. 1 boiler house, increasing the number there to four. Have extended railroad to the boiler houses, so that fuel can be delivered from cars without extra handling. We have eight frame dwellings, one a boarding-house, complete and under way, also a school-house. Shall before winter have forty-five log houses ready for occupation.

We are busy about the plant for No. 2 shaft. This is a duplicate of No. 1 Auxiliary engine, and slight modification of drum. Some further dwelling houses and possibly a third head of stamps will be necessary next year.

The following are the results of the mine operations for the closing six months of the year 1887, July 1 to Dec. 31:

Product of mineral was 6,070,600 lbs, which yielded 76.7 per cent.=4,617,87.1 lbs of ingot, and sold at an average of 12.88 cents per pound, giving	\$594,805 33 183,905 45
Smelting, transportation, and all expenses of making copper	64,823 43
	\$248,728 88
Showing a net profit of	346,076 45
Add balance of assets, July 1, 1887	25,445 26
	\$371.521.71

Deduct amount expended in mine plant during 6 months and it leaves a balance of		
assets Jan, 1, 1888	\$279,76	5 48
Refined copper cost at the mine	cents per	r lb.
Cost for smelting, freight, and all other expenses	66	4.6
Total cost of refined copper per lb. in N. Y. and sold	4.6	4.6
Add cost of sinking No. 2 shaft and it makes the copper cost	65	46
Assets and Labilities January 1, 1888.		
Assets, omitting details	\$546,55	5 03
Total liabilities, omitting details	266,78	9 55
Balance of assets, Jan. 1, 1888	\$279,76	5 48

The officers are, J. W. Clark, President; A. S. Bigelow, Secretary and Treasurer, 246 Washington St. Boston; John Daniell, Agent, Opechee, Mich. Capital stock, \$1,250,000, divided into 50,000 shares of \$25 each. Annual meeting occurs first Thursday of October of each year.

THE TAMARACK JR. MINING CO.

is a company recently organized by the owners of the Tamarack to sink two shafts in the east half of the S. E. 4, Sec. 11, 56, 36. The shafts are located, one in the center of each 40. This land joins the Centennial mine on the west and the expectation is, that the shafts at the proper depth will intercept the "copper shoot" now reached in No. 5 Calumet mine shaft.

At any rate enough confidence is felt in the existence of productive copper ground in this land to induce the undertaking of sinking at great depth to find it. Both shafts are under way; No. 1, a three compartment shaft, is down 150 feet, and No. 2, four compartment, is 80 feet. They use a Rand compressor, four power drills and are perfecting arrangements to push the work vigorously under the direct oversight of Capt. John Cruse.

Besides the land above mentioned there has been set off to this company the S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$ of the same section; in all 120 acres, being $\frac{1}{2}$ mile wide and $\frac{3}{4}$ of a mile long north and south.

No. 1 is in the south 40, and No. 2 in the middle 40. I have not estimated the depth which they will have to go to reach the conglomerate, but judge it will be about 2,400 feet.

The number of shares is placed at 50,000, par value being \$25 each. At a meeting of the directors of the Tamarack Mining Co. held February 25, 1888, it was ordered that the stockholders of this company be offered the right until May 15, 1888, to subscribe to 40,000 shares of said Tamarack Junior Mining company pro rata, that is, one share for every share held in this company April 9, 1888, payment to be made to the treasurer of the Tamarack Junior Mining Company as follows:

June	1,	1888	 \$3.00 a share
May	1,	1889	 3.00 a share
May	1,	1890	 2.00 a share
Mav	1.	1891	 2.00 a share

That upon payment into the treasury of the Tamarack Junior Mining company of the first instalment of three dollars a share, this company is to execute a a deed to the Tamarack Junior Mining company of the land set off for the mine.

THE CALUMET AND HECLA CO.

had great fortune, both ill and good in the past year. The former has consisted in the fire that has raged in the mine so many months, and the latter in the remarkably favorable results obtained at the South Hecla; a part of the mine of which, comparatively, very little reckoning was made a few years ago, but which under the spur of necessity has been rapidly opened and developed, and found to be unexpectedly rich and productive, furnishing an output nearly equal to that of the entire mine previous to the fire.

The Calumet and Hecla mine has a working length of 4,000 feet. The central or main portion is entered by 7 shafts, which are sunk to the 28th and 39th levels, a vertical depth of 2,300 feet, and a depth in the plane of the lode of 3,800 feet, and a width of from 8 to 27 feet. The hanging wall, a trap belt, is a bad one, broken and fragmentary, or tending to speedily become so if left to itself. To hold it in its place requires much artificial support. The mine is a network of fine timber; millions of feet of dry pine; the best of fuel for a great conflagration, and to such a calamity there is, inevitably, constant danger.

Such an occurrence happened on the 4th of August last; a fire broke out in the 16th level, near No. 2 Hecla shaft, which caused the closing of the mine and the vigorous application of water, steam and gas to extinguish it. Probably it never was completely put out, but work was resumed after a few weeks' delay and proceeded without further interruption until November 20, when the fire again broke out and all the shafts were immediately sealed at the surface as tightly as possible, and the work of manufacturing and injecting carbonic acid gas into the mine was begun. The fire at first raged with much apparent fury; the smoke emanated from the shafts with a good deal of force, and while the fire was abated somewhat, and got under partial control, it has been a very slow, expensive, difficult matter to extinguish it wholly. However, after more than six months of constant effort, the mine is again opened, and they are now removing the water, with which the mine is more than half filled. Probably by the middle of July the company will

be again hoisting copper from this, the main body of the mine. As the Black Hills or South Hecla is more than a half a mile south of and wholly unconnected with the main mine, it was not of course affected by the fire. And thus it transpires that the South Hecla, by force of circumstances, has become during all these months the sole producer, and being worked to the fullest extent it has been made to yield nearly as much copper as was previously obtained from the whole mine. It so happened, fortunately, that the South Hecla was well opened and little stoped, so that the shafts could all be used exclusively for hoisting stamp rock. Still sinking has been carried on, as the shafts which were at the 10th level when the fire occurred are now to the 11th, 12th and 13th levels. The mine is about 1,000 feet long and 1,200 feet deep. It is not all good ground. The conglomerate is found to be very wide, thirty feet maximum width. There are four working shafts. which are numbered from the north to the south, 9, 10, 11, 12. North of these two others are sinking, 7 and 8, which will have to penetrate to a considerable depth before they reach to the "copper shoot" found in the other shafts.

Nine and ten constitute a double shaft, though operated separately, the machinery for No. 9 being placed in an engine house north of the shaft, while the machinery for No. 10 is contained with that for 11 and 12 also, in a building to the south. Each shaft has a rock breaker; these receive all the rock of suitable size and thence pass it into the rock bin below, from where it is drawn out into cars and sent on to the stamp mill. If too large for the breakers, the rock is sent under the stone hammer and thence through a breaker.

The compressors at the mine are not used. The air is now brought from the main compressor plant nearly a mile away.

The deepest of the shafts is No. 12, next to the Osceola line, which is to the 13th level. No. 11 is to the 12th, and 9 and 10 to the 11th. The lower levels at No. 12 have been extended towards the south until they ceased to show any copper. The belt in that part is narrow and lean. The best ground is at Nos. 9 and 10 shafts. They leave heavy pillars, 85 feet wide, on each side of the shafts; 170 feet of solid ground left standing at each shaft in every level.

The ground is untouched from the 2d level up to surface, left for support. A notable fact exists: they are having a mass of copper in the mine; have already cut 9 tons from it. It is a slab of copper resting horizontally in the conglomerate. Mass copper is heretofore a rare or unheard of occurrence in this conglomerate.

The company has built a new engine house for the Hecla mine, situated

north of the South Hecla. It is a fine stone structure with a brick smoke-stack 213 feet high.

The old one will be used for compressor plant.

The stamp mills at Like Linden have been enlarged and now contain 15 head of stamps, 7 in the Hecla mill and 8 in the Calumet, of which 11 are now, March, worked.

The company is adding three more to the Calumet mill which will then make the number 11. A few years ago the arrangements of these mills might justly be criticised, it is not so now, they work admirably, and apparently with as much economy as any mills in the country.

The mineral is run automatically into cars standing on the track in the mills, and thence the cars are drawn by locomotive to the store house at the smelting works about a mile away. The company now smelts all its own copper at Lake Linden.

No. 5 shaft, the most northern one of the mine, is down to the 34th level, and is watched with interest by outside parties as well as by the company, from the fact that it is showing well in copper, and that the copper makes to the north as it goes down.

The company returned to the shareholders in 1887, \$15 per share, making a total to July, 1888, of \$30,350,000.

Table of product of C	lumet and Hecla mine:
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Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
867	657	1,173	1878	12,626	1,12
.868	2,549	375	1879	13,135	943
.869	6,157	1,771	1880	15,837	1,239
870	7,030	1,584	1881	15,680	781
871	8,111	590	1882	16,026	1,528
872	8,081	183	1883	16,562	1,048
873	9,424	265	1884	20,236	1,58
874	10,062	1,225	1885	23,623	1,990
875	10,736	1,954	1886	25,259	220
876	10,845	732	1887	23,008	123
877	11,284	468			

Mr. J. N. Wright, General Superintendent, Calumet, Mich.; Alex. Agassiz, President, Boston, Mass.

The following official statement of assets and liabilities, April 30, 1888, has been issued by the Calumet & Hecla Mining Company:

Assets.

Cash at mine		\$67,127	
Cash at New York office		7,746	65
Cash at Boston office, and copper at 9c		2,407,449	57
Bills receivable at mine		31,359	63-
Total		\$2,513,681	49
Liabilities.			
Drafts in transitu	\$71,539 21		
Employés' Aid Fund	2,388 00		
Bills payable at mine	146,285 14		
Bills payable at Boston	100,000 00		
Machinery contracts, "estimate,"	200,000 00		
New smelting works	50,000 00	599,772	35
Ralanca		\$1 953 909	14

THE CENTENNIAL MINING CO.

now holds the whole of Sec. 12, 640 acres, T. 56, 33, adjoining the Calumet and Hecla on the north. The section is crossed by the Calumet and Hecla conglomerate and the Osceola amygdaloid. The former enters at about the south quarter post and runs N. 35° E. to the the post in the east line of the north half of the section, thus giving a surface length of the conglomerate on the property of about 4,800 feet. Thus the greater portion of the section is underlaid by the conglomerate, enough for a mine of the largest dimensions if it is sufficiently charged with copper. The work done by the old Schoolcraft company at this mine did not prove to be favorable. The conglomerate, as far as it was tested, did not contain enough copper to be of any value. Work subsequently done in the amygdaloid gave better results. In former reports I have described the work done in both these copper belts.

It seems, in the light of all that is now known of this great copper belt, to be the wise thing for the company to sink a deep shaft, to go down in the lode, and it is quite possible that paying ground will be found. The copper "shoot" in No. 5 Calumet shaft affords evidence that it may reach this property. Still greater is the probability that in the long stretch of ground between this No. 5 shaft and the Centennial line other good copper "shoots" may occur, in which case they certainly will be in the Centennial land also. It is a matter worth the trial. The company has all the requisite machinery for sinking such a shaft.

S. L. Smith, President; Josiah Hall, resident Agent.

THE KEARSARGE MINING CO.

has kept at work in a moderate way in its property, the S $\frac{1}{2}$, S. 6, 56, 32. The work is all in the way of exploring and is sufficiently favorable, that with the general confidence placed in the management, cause the stock of the company

to rate well in the market. It is not necessary to say more of the mine than is embraced in the company's report.

KEARSARGE MINE REPORT.

The directors present the following report of the operations for the past year, and statement of the financial condition of the company:

The product of mineral was 27,874 pounds, which, at 76.19 per cent. gave 21,237	pounds	
of refined copper, for which has been realized the gross sum of		\$3,408 92
From interest receipts	******	2,551 13
From assessment No. 3		40,000 00
Add balance of assets, Jan. 1, 1887		73,627 45
The costs have been:		\$119,587 50
Running expenses at mine \$4	6,991 02	
Smelting, transportation, and sundry other expenses	1,515 63	
\$4	8,506 65	
There has been expended in mine plant during the year 1	4,601 29	63,107 94
Making the balance of assets January 1, 1888		\$56,479 56
Our operations thus far have been confined wholly to opening the i	mine pro	eparatory

to stoping and producing copper.

We are now in a position to test our mine, and have good reason to believe that the

developments in the near future will show gratifying results, and that we shall be classed among the regular producing mines.

We can arrange with the Osceola mine to stamp for us what rock may be available for the present, and until we can feel warranted in erecting a mill of our own.

The reports of our treasurer and superintendent are herewith submitted, giving detailed accounts of the present condition of the company.

CHARLES VAN BRUNT, President.

ASSETS AND LIABILITIES.

Assets.		
Cash in bank at Boston	\$16,634 61	
Cash on hand at mine	139 89	
Supplies on hand at mine	561 39	
Fuel on hand at mine and stamp mill	2,151 16	
Accounts receivable at mine	1,552 42	
Bills receivable at Boston	3,910 00	
Assessment No. 3	15,576 00	
250 shares Hancock & Calumet R, R. stock	25,000 00	
Copper on hand, 21,287 pounds	3,408 92	
Total assets		\$68,934 39
Liabilities.		
Drafts outstanding	\$5,283 05	
Accounts payable at mine	7,171 78	
Total liabilities		\$12 454 83
Balance of assets January 1, 1888.		\$56,479 56
STATEMENT OF RECEIPTS AND EXPENSES OF ALL KINDS	١.	
Receipts.		
From capital stock, 50,000 shares, \$13 a share paid in		\$650,000 00
From 21,237 lbs. copper 1887, at 16		3,408 92
" interest receipts to date		3,648 95
Total receipts		\$657,057 87

Expenses.			
Running expenses prior to 1887	\$20,361 72		
Running expenses during 1887	48,506 65	\$68,868 37	
Construction expense prior to 1887	\$13,962 21		
Construction expense during 1887	14,601 29	\$28,503 50	
Real estate		474,000 00	
Total expenses			\$600,578 31
Balance of receipts January 1, 1888			\$56,479 56

SUPERINTENDENT'S REPORT.

OPECHEE, February 8, 1888.

To the President and Directors, Kearsarge Mining Co.:

GENTLEMEN:—I beg to submit the following report of the past year's operations.

Our work has been confined wholly to development; the copper taken from the mine coming from the openings and in the shape of mass and barrel copper. We sent to smelting works 27,874 pounds of mineral. This afforded 21,237 ingot, or in excess of 76 per cent.

Development has shown that overlying the lode on which we commenced operations and usually distant 30 to 40 feet from it, there is another bed of amygdaloid from 3 to 4 feet wide, occasionally wider. This last runs in nearly a straight course, while the main lode, very irregular in size, takes a very circuitous course, sometimes approaching the west lode very closely, and again leaving a well-defined trap between. At more than one point we have found in cross-cutting from one bed to the other, that the intervening material is wholly amygdaloid, leading to the inference that both should be taken as one lode. At 5th level, No. 1 shaft, this is especially the case, but I cannot say that I am settled in opinion as to its correctness. Should this prove to be so, our chances of finding heavy deposits of copper in depth would be good. We look to early developments at 6th level to throw light on the question.

During the year No. 1 shaft has been sunk 344.7 feet. At this time it is down to 6th level. This shaft has been in line of, and near to the west lode I have referred to. It has shown a little copper, but the width of the copper course is too narrow to rate it as ordinarily profitable. About half way between 4th and 5th levels we found in the shaft a mass of copper which weighed over 4 tons, and at 5th level, in cross-cutting east, we encountered another of nearly three tons. This last lay in the ground between the two lodes.

No. 2 shaft has been sunk 347 feet, and is now down to 6th level.

Cross-cutting east is going on from both shafts, and I am hopeful that we will find profitable ground when the lode is encountered.

Including cross-cut, 80 feet, there has been drifted at 50th level 634.9 feet. The level has been holed from shaft to shaft. In the vicinity of No. 2 shaft we drifted through 165 feet of copper-bearing ground that in places is quite rich. We rate it as being all good stoping ground. Later, in drifting north of No. 2, for 100 feet we have had a promising lode carrying only a little copper. The ground in vicinity of No. 1 shaft, at 5th level, has not been good for copper, quite promising at times, but not profitably productive. It must be remembered that the lode in places is very wide, and we cannot claim that the drivage shows fairly what it contains. At this time we are crosscutting in 5th level to determine the full width and value of the lode. Though we have drifted 20 feet, we have not yet seen the foot-wall.

The 4th level has also been communicated between shafts. In this level we found the most productive ground near No. 2 shaft, and laid open in one stretch 110 feet of very good ground. At three other points we found ground we can count on stoping. Going north of No. 2 shaft we have carried a very promising lode.

The 3d level was driven north of No. 1 shaft on the west lode about 250 feet. This opening showed 100 feet in length of stoping ground, but rather narrow so far as seen. From No. 2, south, the opening is on the east or main lode. It looks as if fully half the ground, 320 feet on the east lode, about and attainable from No. 2 shaft, would be good.

The 60 feet drifted at 2d level, to make connection between shafts, afforded considerable heavy copper, and here we count on good stoping ground. Neither north of No. 2 shaft, nor south of No. 1 shaft, have we found anything valuable at this level.

At first level, north of No. 1 shaft, we have drifted 89.1 feet. The lode here is quite good for copper, and though, as elsewhere, it is bunchy, it will all afford good stoping ground.

In summing up I would try to embrace the more salient points in the following. Our mine, as those on amygdaloid lodes generally are, must be termed bunchy. The lode in places is very wide, and as yet we do not know enough of it to say that those places in the openings, which do not show a fair quantity of copper, must necessarily be poor. Stoping must determine this. It would have been more satisfying if the copper ground exposed was more in proportion to the whole length opened; but if that of which we are necessarily doubtful, until further proved, turns out fairly, then we have every reason to expect a good and lasting mine. The course we have pursued in opening the lode quite extensively, before making any effort to produce copper, I regard as very judicious, for we have now attained a sufficient depth to admit of fully proving it, without spending largely for its equipment in advance of really knowing what we have.

The drifting for the year foots up as follows:

1st level	89.1	feet.
2d ''	410.4	6.6
3d "	692.5	66
4th "	705.3	. 66
5th "	641.9	6.6
Total2	,539.2	feet.

Of this drivage 280 feet would properly come under the head of cross-cuts.

Our construction account gives in detail the expenses in that direction; the principal expenditure being on account of a 22x42 air compressor, boiler, heater, house, etc., for same. The machine is doing good duty, and we think is equal to running 18 drills. At this time we are framing a rock house. This is to be ready for erection as soon as the weather permits. Much of the grading necessary for railroad approaches to rock house has been done. Early in summer we should be producing copper regularly.

With this you should receive the mine plans and detailed statement of the year's expenditures.

Yours very respectfully,

JOHN DANIELL, Superintendent.

THE WOLVERINE MINE,

Situated just south of the Kearsarge, remains idle. The legal controversy regarding the title is not terminated.

ALLOUEZ MINING CO.

has resumed possession of its mine. The lessees, Messrs. Watson & Walls, having failed financially, the company was obliged to again take hold of its mine. As matters have turned out, and considering the great change for the better in the copper market, it would have been to the advantage of the company not to have leased the mine at all; but to have pushed the openings and had the mine in readiness for producing copper largely when the rise came. Now it happens that the price of copper has advanced to a highly advantageous figure, and the Allouez people are engaged in getting ready to mine it. The machinery, also, requires thorough overhauling, all of it, hoisting, rock house, stamp mill and railroad.

In the mine the company is sinking and drifting at this date, June 1, in Nos. 1 and 2 shafts. The latter is on its way down from the 17th level, going to the 18th. They are drifting south in the 17th level and in the 12th. Also in No. 1 they are drifting in the 7th level.

Besides repairing that now on hand, some new machinery is required. A new hoisting plant will be supplied at No. 1 shaft, and two new boilers will will soon be added to the steam generating apparatus. The company will thus not be in readiness to produce much metal until, perhaps, October.

Mr. Fred Smith continues as Agent, and Ned Roscorla, Mining Captain.

ALLOUEZ MINE REPORT.

No. 76 WALL STREET, NEW YORK.

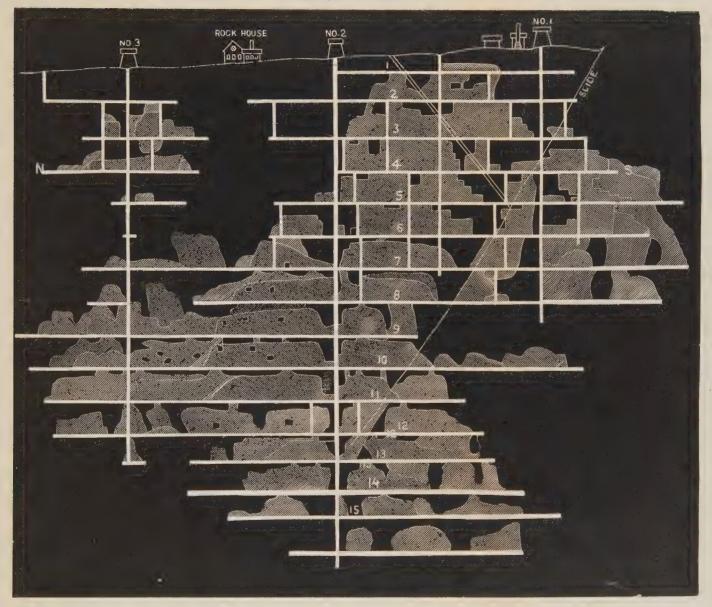
The directors present herewith a summary of the receipts and expenditures during the year 1887, and statement of the assets and liabilities of the company at the close of the year, showing a balance of strictly available assets of \$48,497.97.

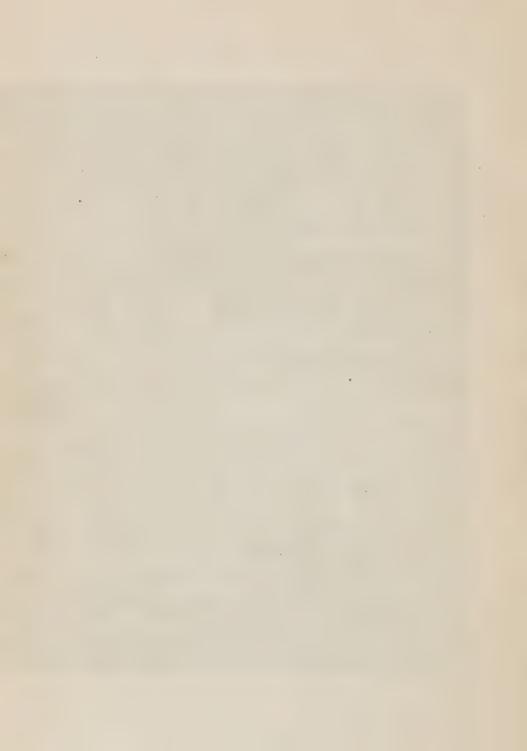
The parties to whom the mine was leased for a term of three years from June 1, 1835, became unable, on account of pecuniary difficulties, to continue working the mine as agreed, and, after struggling along and making a limited production during the early part of 1887, they finally succumbed to the pressure of the ten per cent. copper market, and in July their property was attached by creditors, and work was stopped. Our revenue from royalty on the copper produced was therefore small.

Possession of the mine was resumed by the company in September. The low price of copper then ruling did not warrant your directors in taking any action looking toward working the mine, neither was such a course practicable under the dilapidated condition in which the surface plant was left by the lessees; but steps were at once taken to protect the buildings and machinery, and to keep the mine free from water and guarded from injury. As the copper market improved, and it became more and more evident that the era of extremely low prices was passing away, the directors determined to commence opening new ground to some extent, and we are now sinking and drifting at some of the most promising points, and preparing for active production as soon as the machinery and buildings can be repaired and put in proper condition for economical operation. This work cannot be undertaken to any considerable extent until the snow

LONGITUDINAL SECTION OF THE ALLOUEZ MINE, JAN., 1888.

Scale, 300 ft. to one inch.





\$50,965 01

has gone, and by the time it can be completed, the mine will be put into condition to fully supply the stamp mill, provided that the stockholders shall at the annual meeting decide upon such a course.

The directors are of the opinion that the present condition of the copper market, and the prospect of a continuance of fair prices, warrant the resumption φf work and the outlay necessary to put the mine and surface plant in good working condition.

STATEMENT OF RECEIPTS AND EXPENDITURES FOR THE YEAR 1887.

Receipts.

Copper sold, 85,640 lbs., av. 10.38 cents.			\$8,896 93
Balance of interest account			709 51
			\$9,606 44
Expenditure.			
Freight and other charges on copper		\$368 42	
Office and other expenses		1,230 34	
At Mine-			
Taxes on property not leased	\$77 78		
Insurance on buildings, etc.	1,322 83		
Fire hose and water pipes	552 45		
Surveying	39 00		
Repairing agent's house	769 59 8 16		
Canal tolls on copper	150 00		
Pay of employees (Oct., Nov. and Dec.)	876 73		
Fuel and supplies (used in same months)	699 86		
Agent's salary and other expenses	1,627 23		
	\$6,123 62		
Less rents received	415 50		
Hess tells received	110 00	\$5,708 13	
Add amount due by lessees not collectible		4,028 08	\$11,334 97
Excess of expenditure over receipts			\$1,728 53
The balance of assets reported Dec. 31, 1886, was		\$59,870 00	
Deduct.			
Accounts receivable—old debts not now collectible	\$451 58		
Amount transferred from "mining supplies," to "mining plant,"			
being tools and implements on hand at time of closing work			
May, 1885	9,192 81	9,644 39	
		-,	50,226 50
			\$48,497 97
			Q 20,20, 0,
Assets and Liabilities, Allouez Mining Co., D	ECEMBER	31, 1887,	
· Assets.		,	
Cash in bank and Trust Company			\$42,984 00
Accrued interest on deposit in Trust Co			538 88
At Mine—			****
Cash in bank		\$639 62	
Fuel and supplies		1,940 06	
Standing timber on 35 acres of land, purchased for mine use, cost.		4,833 94	
Accounts receivable		28 51	
			7,442 13

Liabilities.

Due employees and others at mine	\$1,765 19 609 26 92 59	
Net balance quick assets, Dec. 31, 1887By order of Directors.		2,467 04 \$48,497 97

Table of Products.

New York, March 1, 1888.

JOHN STANTON, Treasurer.

10,389

733

		1			
Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1869	1	1,575	1880	658	471
1873	10	1,163	1881	736	1,007
1874	504	130	1882	841	1,557
1875	692	1,574	1883	875°	1,337
1876	780	1,785	1884	964	. 174
1877	650	479	1885	1,085	476
1878	565	1,146	1886	862	1,468
1879	715	1,452	1887	442	1,010

THE CLIFF COPPER MINE,

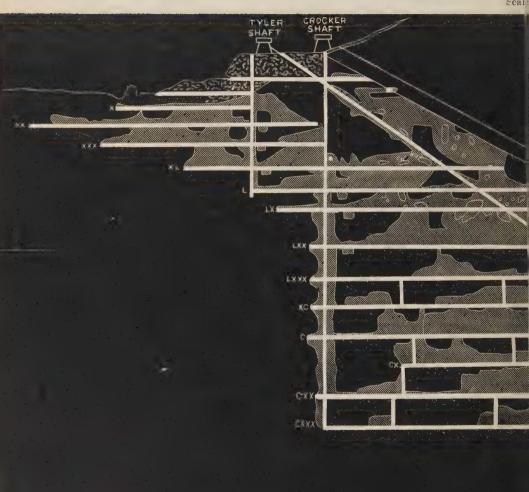
once the great bonanza of Lake Superior, is the first fissure vein mine met with north of Portage Lake. A detailed description of this celebrated mine is given in the Com. Report for 1880, and subsequent reports have brought the matter up to date. No work has been done in the past year. What the old mine may contain still hidden from sight away down in its depths, or what may lie elsewhere undiscovered beneath the surface of the property to reward future exploration, is only a matter of conjecture.

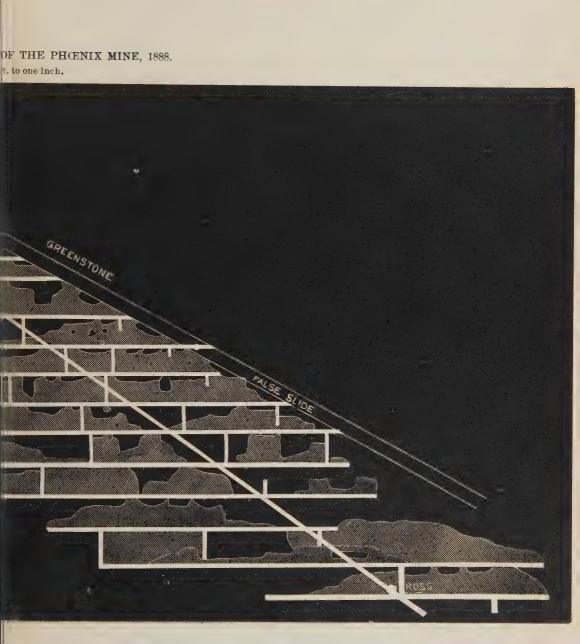
The Cliff has produced as follows:

SOUTH CLIFF No.4 LEVEL SUPERIOR H coxx CLXXX CXC င္ပင

LONGITUDINAL SECTION OF THE CLIFF MINE, 1888.
Scale, 600 ft. to one inch.

LONGITUDINAL SECT







Year.	Tons,	Pounds.	Year.	Tons.	Pounds.
Prior to 1855	3,400		1871	71	238
1855	937	197	1872	. 59	386
1856	1,110	934	1873	357	1,203
1857	1,118	850	1874	527	901
1858	1,130	433	1875	581	873
1859	707	1,007	1876	450	146
1860	921	1,303	1877	80	1,319
1861	964	11	1878	207	415
1862	1,002	960	1879	67	336
1863	1,050	354	1880	30	962
1864	675	1,334	1881	39	1,382
1865	747	626	1882	33	53
1866	821	428	1883	5	374
1867	560	1,725	1884	14	255
1868	613	746	1885	4	332
1869	362	1,247	1886	11	342
1870	222	381	1887		
Total				19,064	1,643

D. D. Brockway, Agent, Phœnix, Mich.

THE PHOENIX MINE

yielded some copper in 1887. The property is held, I believe, by J. H. Chandler, Esq., of Chicago. The mine is one of the oldest and largest of the copper mines of the state and has a checkered career. Its full history has been heretofore given.

Capt. Jas. Bath is resident Agent.

The following table shows the product:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
Previous to 1855	19		1871	609	1,802
1855	3		1872	364	420
1856	8		1873	260	1,080
1857	17		1874	699	400
1858			1875	702	276
1859	28	590	1876	698	530
1860	20	62	1877	511	493
1861	34	790	1878	150	1,172
1862	31	1,590	1879	272	1,436
1863	72	118	1880	218	10
1864	142	187	1881	204	1,357
1865	202	1,000	1882	268	1,177
1866	206		1883	256	291
1867	155	115	1884	310	1,004
1868	130		1885	180	1,108
1869	398	930	1886	50	1,804
1870	499	1,040	1887	6	1,497
Total				7,731	39

THE ST. CLAIR MINE

has become also, temporarily, a non-producer. The mine is opened in a fissure vein, which has yielded in the aggregate 505 tons 1,071 lbs. of copper. Capt. Jas. Bath is resident Agent.

THE CENTRAL MINE

is one of the most interesting as well as one of the best copper mines in the peninsula. It is in a fissure vein, and retains its productiveness unimpaired. There is nothing new to be said of it.

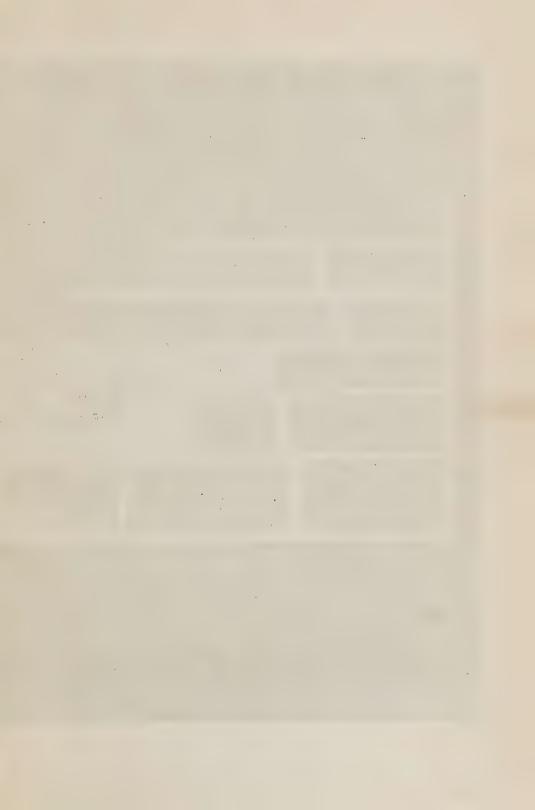
The new hoisting machinery works satisfactorily, and the mine is in excellent shape. It is 2,300 feet in depth, vertical.

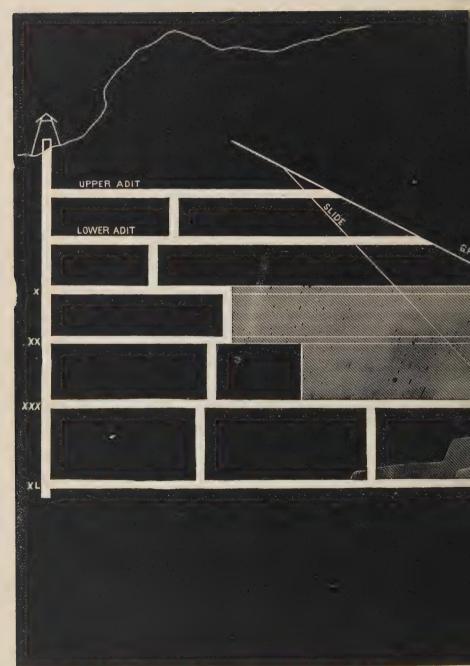
The company now owns the old Northwestern Mining property, and is doing some exploring work in the old mine. It joins the Central on the east-

CENTRAL MINE REPORT FOR THE YEAR 1887.

The directors present the following statement of the operations during the year 1887: The production of mineral was 1,219.1390 tons, which yielded about 78.84 per cent., or 1,923,279 pounds of refined copper. The shipments amounted to 2,199,133 pounds of refined copper, including 275,854 pounds of the product of the previous year, all of which has been sold.

The following is a summary of the year's business:









Production.

1,923,279 lbs. copper, at 12.12 cents	\$233,045	41
Silver	437	77
	\$233,483	18
Add interest received	3,903	74
	\$237,486	92
Costs.		
Working expenses at mine		
Construction account at mine 12,552 12		
Smelting, freight and all other expenses		
Making the total expenses.	195,291	06
And showing a net profit in 1887 of	\$42,095	86
There has also been credited real estate for "stumpage"	3,286	02
Making the net increase in assets	\$45,381	88
The surplus from 1886, after payment of dividend, was	216,104	31
Making the net surplus, Dec. 31, 1887	261,486	19
as shown in detail in the annexed statement of assets and liabilities, and out of		
which a dividend of two dollars per share (\$40,000) was paid February 1, 1888		

The expenditure for construction completed the new hoisting plant named in previous report. This machinery works satisfactorily, and provides ample power for many years to come.

The product for the year, although a fair average, is not as large as was expected at the beginning of the year, and shows a decrease of about twenty-four per cent. from that of the previous year. In the early part of the summer the vein in several of the stopes became small and poor, and the yield was very light until towards the close of the year, when some rich ground was developed in driving the 27th level south, which added materially to the product. This decrease in the production accounts for the diminution of profit, notwithstanding a material increase in the average price obtained for the copper, which was caused by the rise in the market value during the last two months of the year.

The improved appearance of the mine continues to this date, and this circumstance, taken together with the better prices obtainable for copper, warrants the expectation that the results of the business of the current year will be more satisfactory.

WILLAM C. STURGES,
JOSEPH E. GAY,
JOHN STANTON,
ROBERT PORTERFIELD,
ALBERT J. HATCH,
EDWIN H. MEAD,

New York, March 27, 1888.

Directors.

ASSETS AND LIABILITIES DECEMBER 31, 1887, EXCLUSIVE OF REAL ESTATE AND MINE PLANT.

A	88	et s	5

Cash	\$67,180 59
Loans	52,040 00
Silver on hand	437 77
Copper on hand, sold	101,168 76
Accounts receivable	14,237 75

\$235,064 87

Merchandise in store	\$3,724 76	
Merchandise in store	20,881 49	
Supplies	33,556 20	
		\$58,162
		\$293,227 8
Liabilities.		
Agent's drafts	\$7,901 55	-
Indebtedness at mine	18,685 58	
Accounts payable	5,154 00	
		\$31,741
Balance of assets		\$261,486 1
(Less dividend, February 1, 1888, of \$40,000.)		
SUMMARY OF RECEIPTS AND EXPENDITURES OF CENTRAL MINING COM	PANY, FR	OM ITS
ORGANIZATION TO DECEMBER 31, 1887.		
Receipts.		
Capital stock paid in		\$100,000 0
Copper sold, including silver		8,404,273 3
Profit on timber sold		79,011 7
Total receipts		\$8,583,285 1
Expenditures.		
Net expenditure for mining operations, buildings and machinery, smelting		
ad marketing copper, and incidental expenses		
Net cost of "Madison" and Northwestern lands	20,730 99	
Total expenditures		6,501,798 9
Balance of receipts		\$2,082,486 1
Deduct dividends paid		1,820,000 0
Net surplus, December 31, 1887		\$261,486 1
Net surplus, December 31, 1887		\$ 261,486 1
Net surplus, December 31, 1887		\$261,486 1
Net surplus, December 31, 1887		
Net surplus, December 31, 1887	ruary 14	, 1888.
Net surplus, December 31, 1887	ruary 14	, 1888.
Net surplus, December 31, 1887	ruary 14	, 1888.
Net surplus, December 31, 1887	ruary 14	, 1888. ar 1887, i
Net surplus, December 31, 1887	ruary 14	, 1888. ar 1887, i
Net surplus, December 31, 1887. (As shown in statement of assets and liabilities.) AGENT'S REPORT. CENTRAL MINE, KEWEENAW COUNTY, MICH., Feb John Stanton, Esq., Secretary and Treasurer, New York: DEAR SIR:—The following report of operations at our mine during respectfully submitted: Ground Broken. Sinking in shafts and winzes 229 feet, average cost. Drifting in vein and cross-cuts, 1,363 10-12 feet, average cost.	ruary 14	, 1888. ar 1887, i
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Average yield of mineral per fathom of ground broken, 759 lbs. Average yield of ingot per fathom of ground broken, 598 lbs.

Expenditure At Mine.

The total expenditure for the year is as follows:

Mining and surface expenses.	\$134,805 09
Stamp mill expenses	16,068 47
Taxes	3,891 67
Construction account.	12,552 12
	\$:67,317 35
Less rents received	4,480 04
Total expenses.	\$162,837 31

SINKING.

No. 2 shaft has been sunk to the 28th level. A winze has also been sunk from the 27th to the 28th level. We cannot say anything about the vein in this winze, as we did not break into it while sinking, but at the bottom it was poor.

DRIFTING.

The 23d level has been extended south of No. 2 shaft 25 6-12 feet. The vein is small poor.

The 24th level has been extended south of No. 2 shaft 213-12 feet through poor ground. The 25th level has been extended 61½ feet south, and 102½ feet north. This level has opened up some very good stoping ground, the vein varying from a few inches to 4 feet in thickness, and has yielded considerable stamp and barrel copper.

The 26th level has been driven 1898-12 feet south of No. 2 shaft. The vein has been variable as in the level above. Sometimes it would be 10 feet thick and quite rich, and again only a few inches thick and very poor, but it has yielded some good masses, with barrel and stamp copper.

The 27th level has been driven south 311 feet, and north 306 feet. These drifts have opened up about 250 feet of very good ground, showing mass and barrel copper. Going south, the vein split and the drift was continued on the east branch, which was supposed to be the main part of the vein and which proved to be very poor, but in coming on with our stopes we found we were on the wrong branch. We then cross-cut west and found a good vein, which has yielded a large part of the copper produced in the latter part of the year.

The 28th level has been driven south $45\frac{1}{2}$ feet, and north $13\frac{1}{2}$ feet. The vein has been about two feet thick, but very poor until within the last few days, when the south drift has exposed a better vein yielding good stamp rock, with a small mass protruding from the bottom of the drift. The north drift continues poor.

We have done considerable cross-cutting at different levels, to make sure that we had not left a part of the vein, and in some cases have been well paid for the work done.

STOPING.

We have four good stopes of 50 feet each in back of the 27th level. Two of them are idle, while we are cutting mass copper in two of them. In one just south of the winze we have 18 men cutting on a mass which I think will yield over 200 tons of copper; it is very pure and free from rock, two of the cuts being over four feet through; this makes it very slow work in getting the copper away, but it will yield more copper than if it were mixed with rock. Two other stopes in this level are looking well, and will produce considerable copper the coming year.

These stopes in the back of the 26th level are almost exhausted, only a little ground remaining in the bottom of the level above.

The stopes over 25th level south of No. 2 shaft have produced considerable copper the past season, although the vein has been rather small for profitable mining.

The back of the 24th level, in the south part of the mine, has been much richer than we expected to find it. As these stopes approached the bottom of the 23d level the vein became larger and better, and produced several small masses, besides barrel and stamp copper.

We have considerable good stoping ground, and if the 28th level proves reasonably good, which seems likely from its present appearance, our prospects for this year are very encouraging.

In conclusion, I would recommend to your favorable notice, the faithful discharge of their duties by my assistants in conducting the business of the company during the past year.

Respectfully yours,

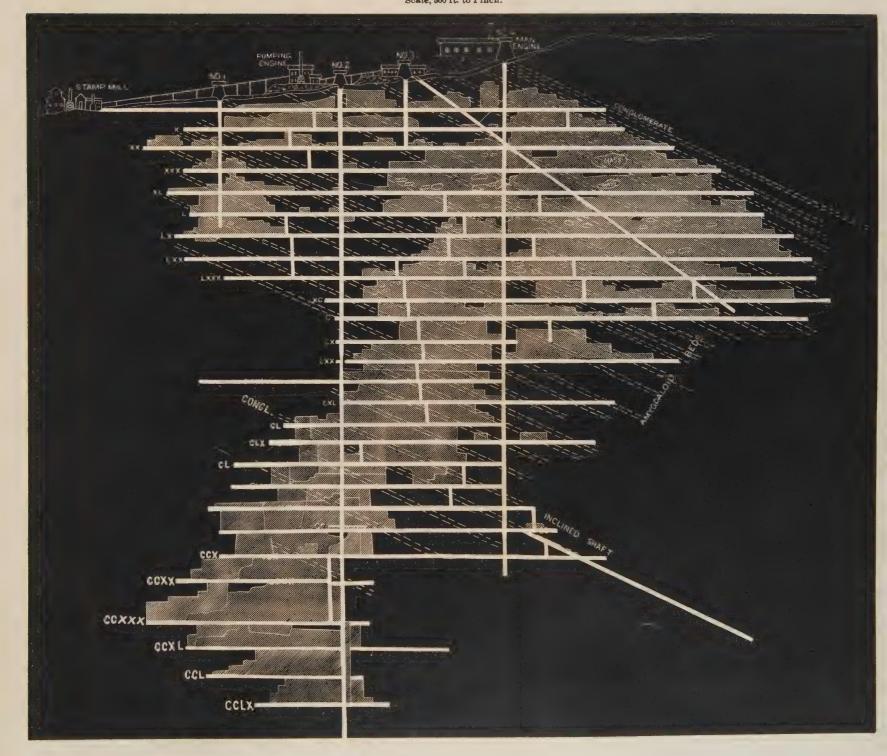
JAMES DUNSTAN, Agent.

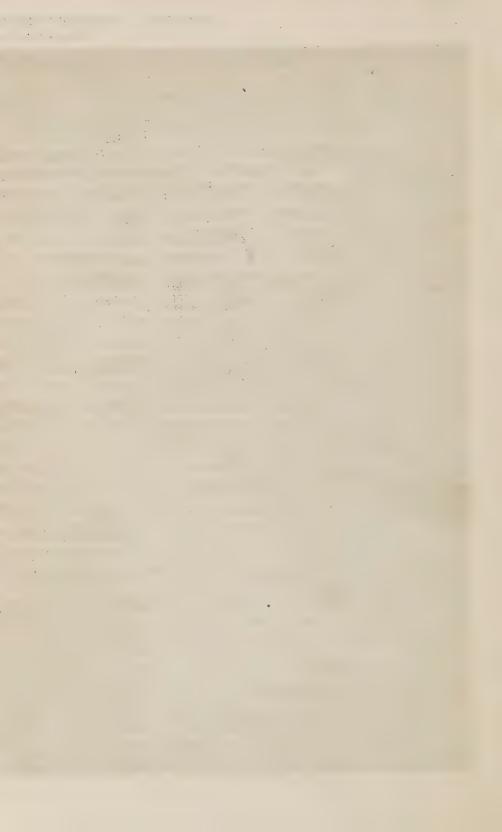
Table showing product of Central Mine—refined copper:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1856	32	403	1872	623	56
1857			1873	751	1,11
1858	71	1,011	1874	870	900
1859	84	312	1875	733	955
860	125	1,370	1876	1,080	1,400
861	70	139	1877	997	1,640
1862	133	1,972	1878	945	1,018
863	278	1,548	1879	899	1,49
1864	381	1,855	1880	1,013	78
1865	346	1,200	1881	709	46
1866	574	1,842	1882	676	1,59
1867	687	745	1883	634	550
1868	1,353	1,827	1884	723	74'
1869	903	1,801	1885	1,078	1,40
1870	663	1,156	1886	1,256	886
1871	716	662	1887	1,099	1,13
Total				19,447	1,17

John Dunstan, Agent; Samuel Bennett, Mining Captain; J. F. Robert, Clerk.

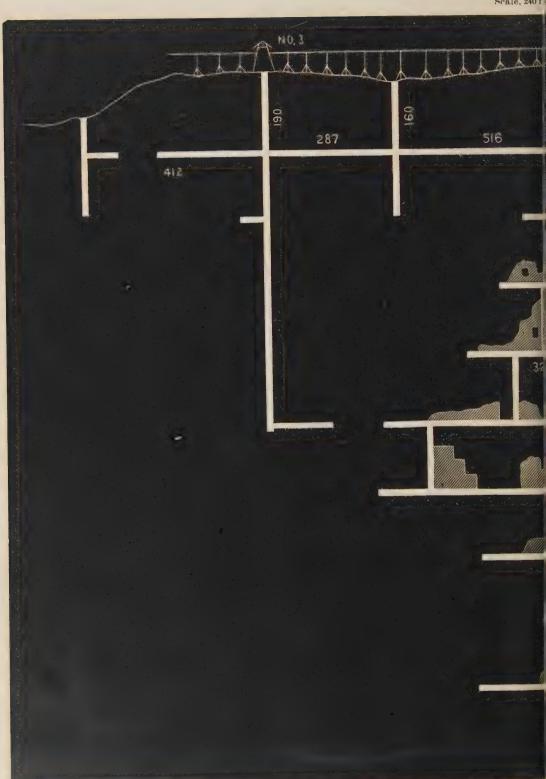
On August 1, next, the company pays its 27th dividend of \$1.50 per share, \$30,000, which makes the total declared to date \$1,860,000.

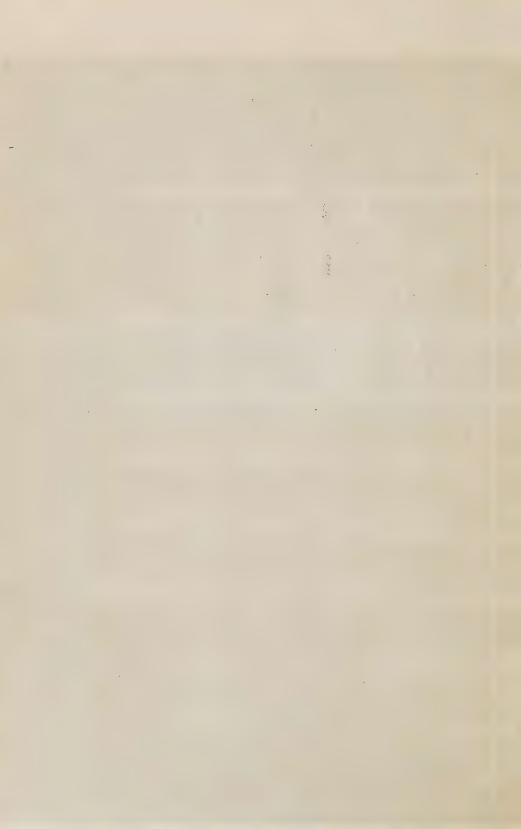


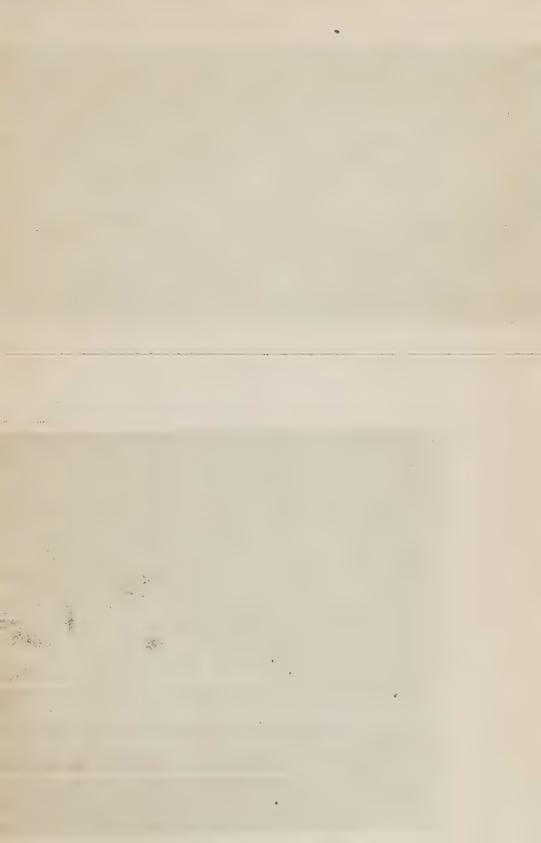


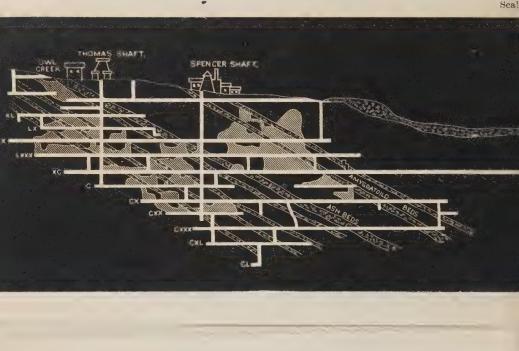


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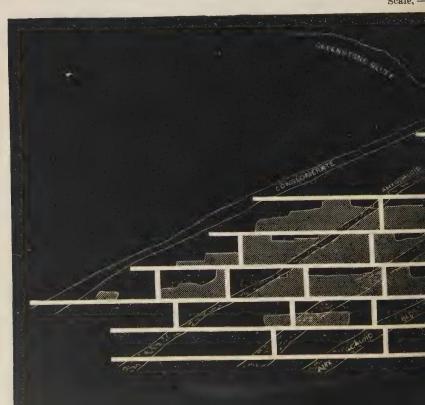




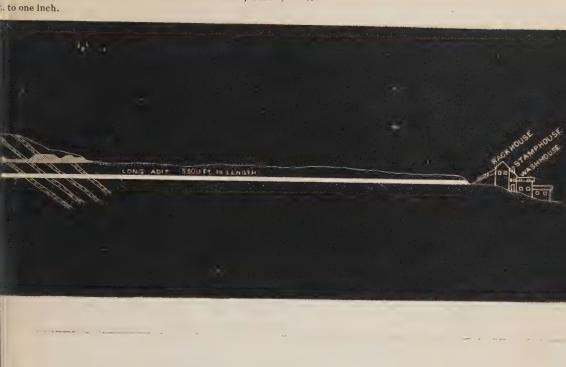


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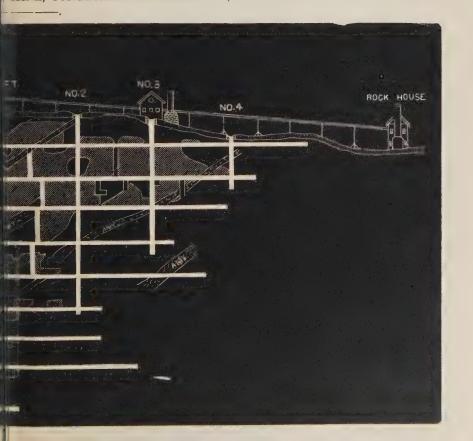
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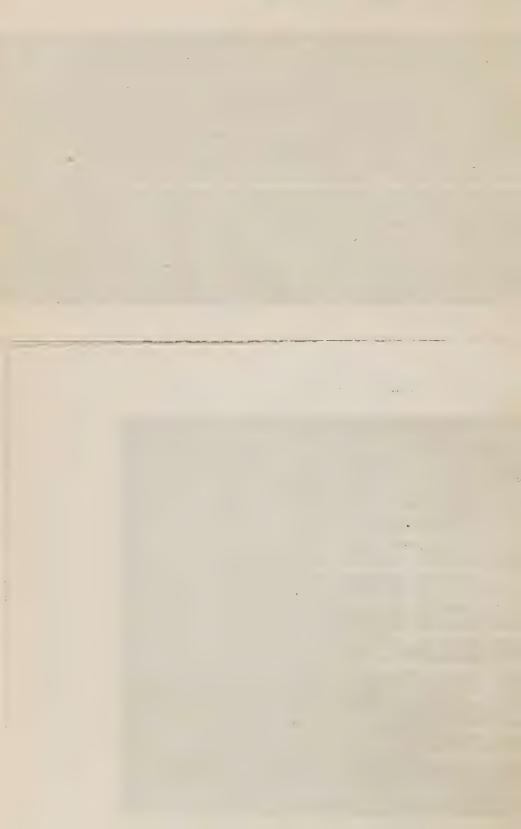


MINE THROUGH THE OWL CREEK VEIN, JAN., 1888.



MINE, CONGLOMERATE MINING CO., 1888.





THE CONGLOMERATE MINING CO.

is doing nothing in the way of mining; everything is as it has been for several years past, and it does not appear to be the present intention of the company to resume work in the mine. It is an old location but was never a prosperous one; far more money has been expended there than the copper has brought. But I know of nothing to state regarding the property beyond what I have incorporated in previous reports, beginning with that of 1880.

Mr. Chas. H. Palmer continues in charge of the mine as resident Agent. The following table shows the copper production at this mine:

Year.	Tons.	Pounds.	Year.	Tons.	Ponnds.
Tears previous and 1855	654	80	1875	12	1,260
856	1	1,348	1876	88	1,701
857	29	543	1877	16	1,417
858	83	100	1878	140	345
859	74	144	1879	70	12
860	121	97	1880	116	1,814
861	54	1,920	1881	193	91
864	111	660	1882	335	1,681
865	241	861	1883	111	117
866	64	90	1884	599	691
867	163	660	1885	20	1,155
872	81	1,161	1886	22	505
873	170	743	1887	4	913
	40	1,271			

THE COPPER FALLS MINE

is again worked vigorously. The stamp mill was not run until near the close of the year, but opening work was continued in the mine, in the ash bed, and in the Owl Creek vein; working south in the latter from the ash bed mainly in the adit level.

It will be remembered that the Copper Falls, which is one of the oldest copper mines in the State, was opened and worked in a fissure vein that crosses the formation at about right angles, i. e., north and south. The mine in this vein,—Owl Creek, so-called—is the one shown in the accompanying map. In crossing the formation the vein, of course, cuts the successive beds of which it is composed, among which is the widely known

amygdaloid belt called the ash-bed; a name given to it in an early day, and which it still retains. The mine is on the north side of the range, where the formation dips and slopes to the north, to the lake. This so-called ash-bed holds an average small percentage of copper, about .80%. In point of fact it is identical with the Atlantic bed, except that the Atlantic mine stands more erect and is wider.

The mine is entered by shafts from the surface, which were formerly only used, but more recently by a long adit shown in the map, which enters the mine from the north; starting from near the level of the low ground that stretches away to the lake. East and west of this adit the ash-bed has been worked in extensively, as I have described very fully in former reports.

The mine is looking as well as usual, rather better, I think, than it has for a few years back. The new openings in the ash-bed are apparently a little improved, and in the vein has been found quite lately considerable copper. There is the feeling of elation about it among the people at the Falls. They hope for prosperity from the new discovery of mass copper south in the vein.

Two heads are now running in the mill.

The Copper Falls is a very interesting mine.

Table of product of Copper Falls mine:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
Previous to 1855	158		1871	239	883
1855	160		1872	260	862
1856	104	10	1873	643	540
1857	153	1,305	1874	535	359
1858	151	1,852	1875	203	1,587
1859	173	174	1876	8	1,488
1860	255	818	1877	5	1,950
1861	280	11	1878	5	1,790
1862	299	299	1879		
1863	159	1,348	1880	3	645
1864	179	808	1881	334	1,121
1865	235		1882	293	1,500
1866	568	1,169	1883	402	× + 0 0 0 0 0 0 0 0 0
1867	1,128	1,485	1884	445	1,168
1868	239	1,384	1885	575	538
1869	345	1,400	1886	689	679
1870	386	990	1887	270	
Total				9,765	133

David Nevins, President, Boston, Mass.; J. H. Moyle, Superintendent, Copper Falls, Mich.

The following tables give the amounts of iron ore, copper and coal, produced by the different companies and individuals in the State in 1887, and the specific tax due the State thereon, as reported by the Commissioner of Mineral Statistics to the Auditor General, prior to May 1, 1888:

Name of Company or Producer.	Tons of Ore.	Specific Tax
American Iron Company, Marquette county	370	\$3 7
Aurora Iron Mining Company, Gogebic county	154,195	1,541 9
Ashland Iron Mining Company, Gogebic county	175,561	1,755 6
Anvil Iron Mining Company, Gogebic county	10,075	100 7
Beaufort Iron Mining Company, Marquette county	12,830	128 8
Buffalo Mining Company, Marquette county	24,686	246 8
Blue Jacket Iron Mining Company, Gogebic county	2,070	20 7
Beta Iron Mining Company, Menominee county	2,811	28 1
Bonnie Iron Mining Company, Gogebic county	1,003	10 0
Brotherton Iron Mining Company, Gogebic county	21,721	217 2
Delaware and Lackawanna Coal Company, Gogebic county	8,411	84 1
Chapin Mining Company, Menominee county	334,026	3,340 2
Cleveland Iron Mining Company, Marquette county	204,828	2,048 2
Cambria Mining Company, Marquette county	41,136	411 3
Champion Iron Company, Marquette county	146,330	1,463 8
Cornell Iron Mining Company, Menominee county	2,064	20 6
Colby Mine, Gogebic county	258,518	2,585 1
Detroit Mining Company, Marquette county	22,656	226 5
First National Iron Mining Company, Gogebic county	1,997	19 9
Delphic Iron Company, Menominee county	1,801	18 0
Fibson Mine, Marquette county	2,700	27 0
Grand Rapids Iron Company, Marquette county	1,200	12 0
Humbolt Iron Mining Company, Marquette county	17,844	178 4
Hamilton Ore Company, Menominee county	514	5 1
ronton Iron Mining Company, Gogebic county	27,887	278 8
ron River Company, Menominee county	82,464	824 6
ron King Mining Company, Gogebic county	74,609	746 0
ron Cliff Company, Marquette county	164,234	1,642 3
ron Chief Mining Company, Gogebic county	2,250	22 5
ron Star Company, Iron county	23,240	232 4
ackson Iron Company, Marquette county	109,941	1,099 4
dillie Mining Company, Marq ette county	23,041	230 4
Lucy Mining Company, Marquette county	11,584	115 8
umbermen's Mining Company, Menomines county	109,119	1,091 1
ake Superior Iron Company, Marquette county	302,909	3,029 0
Asstodon Iron Mining Company, Iron county	49,115	491 1

TABLE—CONTINUED.

Name of Company or Producer.	Tons of Ore.	Specific Tax
Metropolitan Iron and Land Company, Goegebic county	217,384	\$2,173 8
Metropolitan Iron and Land Company, Iron county	9,069	90 6
Millie Mining Company, Menominee county	1,163	11 6
Michigamme Company, Marquette county	51,975	519 7
Milwaukee Iron Mining Company, Marquette county	50,471	504 7
North Champion Iron Company, Marquette county	883	8 8
Norwood Mine, Marquette county	2,200	22 0
Nanaimo Mining Company, Menominee county	30,460	304 6
Negaunee Mining Company, Marquette county	5,259	52 5
Nonpariel Iron Mining Company, Marquette county	1,578	15 7
Paint River Iron Company, Iron county	10,240	102 4
Pabst Mining Company, Gogebic county	19,906	199 0
Pittsburgh and Lake Angeline Mining Company, Marquette county	191,121	1,911 2
Phœnix Iron Mining Company, Marquette county	1,605	16 0
Puritan Mining Company, Gogebic county	42,066	420 6
Penn Iron Mining Company, Menominee county	321,574	3,215 7
Perkins Mine, Menominee county	16,834	168 3
Pittsburgh and Lake Superior Iron Company, Marquette county	47,454	474 5
Palms Iron Mining Company	1,600	16 0
Richards Iron Company, Marquette county	1,374	13 7
Rolling Mill Mining Company, Marquette county	1,078	10 5
Republic Iron Company, Marquette county	220,142	2,201 4
Republic Reduction Company, Marquette county	87	8
Swanzy Iron Mining Company, Marquette county	2,842	28 4
Sunday Lake Mining Company, Gogebic county	18,938	189 3
Sheldon & Shafer Mine, Iron county	2,379	23 7
Stephenson Mining Company, Menominee county	3,589	35 8
Selden Iron Company, Iron county	1,302	13 0
South Buffalo Mining Company, Marquette county	4,914	49 1
Fitan Iron Mining Company, Marquette county	16,003	160 0
Valley Iron Mining Company, Goegebic county	322	3 2
Wetmore Mine, Marquette county	3,335	33 3
Webster Mining Company, Marquette county.		20 5
Winthrop Hematite Company, Marquette county		980 7
West Republic Mining Company, Marquette county	12,777	127 7
Wheat Iron Mining Company, Marquette county	17,538	175 3
Walpole Mine, Menominee county	1,740	17 4
Youngstown Iron Mining Company, Iron county	34,418	244 1
York Mining Company, Marquette county.	5,556	55 5
York Iron Mining Company, Iron county	1	354 3
torn from mining company, from country	00,400	004 0

Coal Production in Michigan in 1887, and Specific Tax Thereon.

Name of Producer.	No Tons.	Specific Tax.
R. H. Emerson & Company, Jackson county	13,230	\$66 15
Spring Arbor Coal Company, Jackson county	500	2 50
Star Coal Mining Company, Jackson county	7,333	36 67
Bennett Sewer Pipe Company, Jackson county	2,317	11 58
Grand Ledge Mining Company, Ingham county	64	32
Corunna Coal Company, Shiawassee county	10,000	50 00
Standard Mining Company, Jackson county	5,000	25 00

Copper Production in Michigan in 1887, and Specific Tax thereon, as reported to the Auditor General by the Commissioner of Mineral Statistics.

Name of Company or Producer.	No. Tons.	No. Lbs.	Specific Ta:
Atlantic Mining Company, Houghton county	1,820	1,865	\$1,365
Allouez Mining Company, Keweenaw county	442	1,010	331 8
Calumet and Hecla Mining Company, Houghton county	23,008	123	17,256 (
Cliff Copper Company, Keweenaw county		145	(
Central Mining Company, Keweenaw county	1,099	1,133	824 (
Conglomerate Mining Company, Keweenaw county	4	913	3 8
Copper Falls Mining Company, Keweenaw county	368	477	273 (
Evergreen Bluff Mining Company, Ontonagon county		1,077	,
Franklin Mining Company, Houghton county	1,957	1,838	1,468
Huron Copper Company, Houghton county	742	103	506 8
Hilton Mining Company, Ontonagon county	8	1,155	6 4
Knowlton Mining Company, Ontonagon county	19	870	14 8
Kearsarge Mining Company, Houghton county	10	1,237	7 9
Mass Mining Company, Ontonagon county	8		6 (
National Mining Company, Ontonagon county	12	1,187	9 4
Nonesuch Mining Company, Ontonagon county	1	5	1
Ogima Mining Company, Ontonagon county		952	
Osceola Mining Company, Houghton county	1,791	1,723	1,343 9
Phœnix Copper Mining Company, Keweenaw county	6	1,497	5 (
Quincy Copper Mining Company, Houghton county	2,804	1,762	2,103 (
Ridge Copper Company, Ontonagon county	42	962	31 8
Rolling Mill Scrap, Houghton county	215	330	
Sundry tributers	34	17	25 (
Tamarack Mining Company, Houghton county	3,702	1,606	2,777
Total product and tax	38,112	927	\$28,584 8



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